ONTARIO AGRICULTURE AND FOOD ENGINEERING RESEARCH AND SERVICES COMMITTEE

2000 REPORT TO

ONTARIO AGRICULTURAL SERVICES COORDINATING COMMITTEE

JANUARY 2000

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LIST OF ACRONYMS

ACAFT	Alfred College of Agricultural and Food Technology
AAFC	Agriculture and Agri-Food Canada
AI	Artificial Intelligence
ARIO	Agricultural Research Institute of Ontario
ASAE	American Society of Agricultural Engineers
CA	Conservation Authorities
CAFT	Centre for Advanced Food Technology
CARC	Canadian Agricultural Research Council
CASCC	Canadian Agricultural Services Coordinating Committee
CAT	Colleges of Agricultural Technology
CC	Canada Committee
CCC	Canada Committee on Crops
CCF	Canada Committee on Food
CFBA	Canadian Farm Builders Association
CFBC	Canadian Farm Building Code
CPS	Canada Plan Service
CSA	Canadian Standards Association
CSAE	Canadian Society of Agricultural Engineering
CURB	Clean Up Rural Beaches (MOE Program)
EFP	Environmental Farm Plan

FRDC	Food Research and Development Centre
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Product
GFTC	Guelph Food Technology Centre
HACCP	Hazard Analysis and Critical Control Points
HRIO	Horticultural Research Institute of Ontario
ICAR	Inventory of Canadian Agri-Food Research
IPM	Integrated Pest Management
IRAP	Industrial Research Assistance Program
ITA	Industry Technology Advisor
KCAT	Kemptville College of Agricultural Technology
LICO	Land Improvement Contractors of Ontario
NSCP	National Soil Conservation Program
NRC	National Research Council Canada
MAP	Modified Atmosphere Packaging
MCCR	Ministry of Consumer and Commercial Relations
MISA	Municipal-Industrial Strategy for Abatement
MNR	Ministry of Natural Resources
MOE	Ministry of Environment and Energy
MMO	Materials and Manufacturing Ontario
MRCO	Manufacturing Research Corporation of Ontario
NBC	National Building Code for Canada

NRC	National Research Council of Canada
NSERC	Natural Sciences and Engineering Research Council of Canada
NSCP	National Soil Conservation Program
OAC	Ontario Agricultural College (University of Guelph)
OAFERSC	Ontario Agriculture and Food Engineering Research and Services Committee
OASCC	Ontario Agricultural Services Coordinating Committee
OATI	Ontario Agricultural Training Institute
OBC	Ontario Building Code
ODWECP	Ontario Drainage Works Erosion Control Program
OFEC	Ontario Farm Environmental Coalition
OFPRSC	Ontario Food Processing Research and Services Committee
OFPRF	Ontario Food Processing Research Fund
OMAFRA	Ontario Ministry of Agriculture, Food and Rural Affairs
OMOH	Ontario Ministry of Housing
ORFEDA	Ontario Retail Farm Equipment Dealers Association
OSA	Ontario Silo Association
OSCIA	Ontario Soil and Crop Improvement Association
OVC	Ontario Veterinary College
PAMI	Prairie Agriculture Machinery Institute
PFRA	Prairie Farm Rehabilitation Administration
R&D	Research and Development
R & RB	Resources and Regulations Branch

SEW	Segregated Early Winning
SOE	School of Engineering
SPOF	Strategic Plan for Ontario's Fisheries
SWEEP	Soil and Water Environmental Enhancement Program
TLV	Threshold Limit Valves
TQM	Total Quality Management
U of G	University of Guelph
UG of AC	University of Guelph Alfred College
UG-RC	University of Guelph Ridgetown College
UTRCA	Upper Thames River Conservation Authority

1.0 EXECUTIVE SUMMARY

The Ontario Agriculture and Food Engineering Research and Services Committee (OAFERSC) presents this report to the Ontario Agricultural Services Coordinating Committee (OASCC) and others interested in research and service activities in agricultural engineering in Ontario. Highlighted in the body of this report is the progress made towards solving previously identified priorities along with any new and emerging issues that have come to light since the last report.

This report will be distributed to all individuals involved in agriculture and food engineering research, development, evaluation, demonstration and service in Ontario. For each subcommittee, the top two priorities are listed below. A more comprehensive list describes Food Engineering priorities. Section 7 of this report is an updated and more detailed listing of all the recommendations made by three engineering subcommittees. The Crops Engineering subcommittee report arrived to late to be fully incorporated in this report. Top research priorities are reported in Appendix 4. The unedited subcommittee report is also included.

1.1 LIVESTOCK ENGINEERING

(see details in section 7)

1. **Livestock Building Design, Construction and Husbandry Systems Relationship to Anti-microbial Resistance, Human and Animal Health.**
   The use of antibiotics in animal production has been linked to the development of antimicrobial resistant bacteria that cause disease and death in humans. To protect human health, authorities in Denmark and Sweden banned the use of antibiotics for disease prophylaxis and growth promotion in animals. However, the same officials strongly recommended correcting the deficiencies in housing and husbandry systems before banning the subtherapeutic use of antibiotics. Corrections to housing and husbandry are critical first steps to avoid sickness, death, compromised animal welfare, and lost productivity in livestock farming without subtherapeutic antibiotics.

2. **Air Quality in Livestock Buildings.**
   Manure odours and gases, dust and dirt, and noise all contribute to the negative perception of air quality in livestock barns for both the animals and the farm workers. Poor air quality has been verified by the excessively high levels of chronic respiratory problems observed in farm workers. Poor air quality is one of the main causes of high labour turn over on livestock farms. Hazardous gases, including silo gas, hydrogen sulphide gas and carbon dioxide have on occasion accumulated to toxic levels and caused fatalities to humans and/or farm animals. Unfortunately, these gases can develop very quickly or go unnoticed until it is too late. Losses of farm animals (particularly swine) continue to occur all too often. It is also expected that there are numerous cases of injuries to the lungs of both humans and animals from sub-lethal levels of these noxious gases.

1.2 FOOD ENGINEERING

(see details in section 7)

1. Improved technologies for pasteurization such as non-thermal processes to reduce processing cost and to enhance nutritional and flavour quality, and shelf life.

2. Baking and frying processes modelling to improve baked and fried products' quality.

3. Image processing for inexpensive in-line methods for detection of glass pieces in glass containers, chicken bones in mechanically deboned chicken and sclerotia (black fungus) in beans.

4. Development of efficient methods for separation, purification and concentration of neutraceuticals from various sources (soybean, tomato, hemp, etc.) to be used in supplements and in fortified foods.

5. In-line sensors for microbial detection, moisture at high temperature for baked foods and dough properties.

6. Raw material characterization for food product quality.

7. Optimizing material handling in the wine industry.

1.3 RURAL ENVIRONMENT ENGINEERING

(see details in section 7)

1. **Investigate methods to reduce livestock manure odours.**
This project involves an examination of various manure treatment options with the specific goal of reducing odour levels at the barn and storage. It is especially aimed at liquid swine manure systems, though the suitability for other livestock types should also be considered. Treatment could occur during collection, during transfer to storage, during storage, or some combination. The feasibility of biofilters, mechanical systems, aeration, bacterial and enzyme methods etc. need to be investigated. There are two phases of odour generation to investigate i) from the barn and ii) from the storage.

2. **To evaluate and quantify the impact of large livestock operations on the rural environment.**
A comprehensive study is required to evaluate and quantify the impact on the environment by large livestock operations. Items that must be studied are:
odours from the buildings
   - odours from the manure storage
   - odours from spreading large volumes of manure

- impact of manure transport on public roads
- ability to handle large quantities of manure and the time required
- volumes of water used and possible impacts on ground water supplies
- effects of concentration of livestock facilities in an area versus spot development
- do MDS formulas adequately assess odour potential of large livestock units

The following emerging needs were identified in 1998 and are still appropriate to 1999:

3. Municipal Bylaws to Control Development of Large Livestock Operations

4. Community Resentment Towards the Establishment of Large Swine Operations

5. Continued Rise in Public Scrutiny and Interest in Non-traditional Components of Water Pollution.

6. Municipal Waste Water Treatment Systems At Capacity and Looking at Less Costly Alternatives - Phosphorous Offset Methods.

7. Draught Conditions in Western Ontario is Stimulating Discussions on Water Rights and Allocation.

8. Drainage Looked at as Contributor to Low Flow Rates in Streams.

9. Methane - Greenhouse Gas from manure

The following are new emerging needs

10. Vegetable Wash Water Quality and Legislative Impacts

11. Livestock Access to Streams and Conflict with Fisheries Act

12. Irrigation Water Quality and Food Safety

13. Nutrient Management Plan Bylaw Court Challenge

14. Impacts of weather to runoff and infiltration

2.0 INTRODUCTION

This is the 2000 report of the Ontario Agriculture and Food Engineering Research and Services Committee (OAFERSC) to the Ontario Agricultural Services Coordinating Committee (OASCC). This report highlights emerging issues as well as provides an update on the progress made towards solving previously identified priorities. Background information for this report was gathered through the four subcommittees of OAFERSC: Crops Engineering, Rural Environment Engineering, Livestock Engineering and Food Engineering. A complete listing of all areas identified by the subcommittees is provided in the appendix and the reader's attention is directed to that appendix for the purpose of gaining a better perspective of the total need.

3.0 MISSION or MANDATE

Following the subcommittee meetings, this committee met on December 3, 1999 in Guelph to consider reports from its subcommittees in order to develop its report for OASCC. Additional discussions were carried out on E-mail or by phone. Each subcommittee has been asked to, as much as possible, outline the social, environmental and economical benefits of the Research and Service priorities. Subcommittees were asked to be specific in their recommendations and to suggest possible partnerships in carrying out research work.

The Livestock Engineering Subcommittee had one meeting during the past year. John Johnson and Harry Huffman attempted to carry out a review of several listings without face-to-face meeting of the committee. It became clear that this would not suffice. Therefore the committee met at the Shur-Gain Research Farm.

Comment from the Food Engineering Subcommittee : Concerns itself with the research and services regarding technology, processes and equipment related to the production side of the food processing. This is in contrast to the Food Science concerns which are food product related. There is of course, a great deal of interdependent, interaction between these engineering and science disciplines.

A meeting of the Rural Environment Engineering subcommittee members was held on November 25, 1999. The previous years report was reviewed and updated. The University of Guelph Environmental program was reviewed last year making this years efforts primarily focussed on reviewing the previous years recommendations and verifying that they were still appropriate to the needs of the time. Consensus was that the recommendations were still appropriate.. The revised structure of OASCC and duties were outlined to the committee. Membership content and possible options to get a greater private sector content were discussed. The views and consensus of the committee is reflected in this report. The majority of committee members were present.

4.0 INDUSTRY/SECTOR SCAN:

4.1 LIVESTOCK ENGINEERING

MAJOR ACCOMPLISHMENTS SINCE LAST REPORT:

Air Quality in Livestock Buildings:

- air quality in livestock buildings (Univ. of Saskatchewan - 0.1 py (person years))
- evaluation of floor applied mineral oil in reducing respiratory dust (Univ. of Alberta - 0.1 py)

Corrosion and Deterioration of Agricultural Building Components:

- corrosion and deterioration of agricultural building components (Univ. of Guelph 0.35 py)

Ice pressures for Manure Tank Design; Manure tank design:

- design criteria for cylindrical liquid manure tanks (Univ. of Guelph 0.35 py)
- Dr. Joffriet at the Univ. of Guelph continues to advance this project (time unknown)
- Innovative design of manure storage tanks (Univ. of Manitoba - 0.54 py)
- A letter to the Standing Committee on Structural Design pertaining to the wording of the National Farm Building Code is proposed. This will be forwarded to the Standing Committee in 1999.

Animal Comfort:

- A behavioural and environmental study to develop improved gestation and farrowing accommodation for sows and litters (Lennoxville, Que - 2.9 py)
- To monitor feed and water intake, nesting and sexual behaviour of broiler breeder hens in open pens (Univ. of Alberta - 0.19 py)
- poultry welfare (Guelph 0.9 py)
- Using natural convection to lower attic temperatures in controlled environment buildings (Univ. of Manitoba - 0.08 py)
- Investigation of installation, cost and durability of four manger surfaces in a tie-stall dairy barn (Univ. of Guelph 0.04 py)

Corrosion of Roof Truss Gusset Plates - A letter was written to the standing committee on Structural Design (National Research Committee, Ottawa) recommending that truss gusset plates that are located in corrosive environments be required to be coated in such a way that protection is offered to the steel. A letter was received from the Standing Committee requesting further information. Clarification and a letter of support from the Truss Plate Institute of Canada is forth-coming.

Technical Information for the Construction Industry:

- Structural behaviour of nail-laminated posts (Univ. of Manitoba - 0.11 py)
- Frost protection using foam (Nova Scotia Agric. College – 0.00 py)

CURRENT STATE OF THE INDUSTRY/RURAL SECTOR:

Beef:

- the Ontario beef industry continues to have it's ups & downs
- much of the cattle feeding is done on contract
- there are not a lot of new barns being built; however there continues to be some feeder barns (200 - 500 head)

Dairy:

- optimism in the industry remains
- the price of quota continues to rise - $17,000/kg of butterfat
- barns continue to be constructed, both by immigrant producers, and established producers
- North America's first commercial robotic milking installation started operation near Plattsville in March. Two farms are now operating exclusively with milking robots, two more are scheduled for installation in September, and possibly two more by December. The two companies offering robots for sale are Lely, and Prolion

Swine:

- barns continue to get bigger in size: 2400 sow barns and 2000 finishing barns are becoming the norm
- society's reaction to proposed swine barns being built is getting much more vocal and organized including legal battling
- municipalities are reacting with restrictive by-laws in an attempt to minimize 'large' barns

Sheep and Goats:

- sheep production is increasing slightly, some as milking herds
- there is a continued increased interest in goat operations.

Poultry:

- producers continue to be very optimistic about this industry and seem prepared to invest big dollars in quota and new facilities. Interest continues to come from older dairy farmers who are switching between the two quota systems. Extremely high quota prices continue (broilers @ $38/unit; egg quota @ $78/hen; turkeys @ $2.60/kg).
- starting in the fall of 98, a new export production policy has allowed additional placement of broiler chickens that is providing optimism for some more growth in this sector. Quota transfers were halted this summer while the board developed a new policy for additional quota allocation.
- the imported hatching egg supply was very tight during 98-99 and resulted in substantially increased prices from U.S. suppliers. This cost was further compounded by our low Canadian dollar. The result has been flock life extensions in an attempt to cover the short fall.
- Ontario has approximately: 1100 broiler producers; 200 pullet producers; 500 egg laying hen producers; and 160 turkey producers.

Fruit and Vegetables:

- the season was 10 days earlier in most areas, but very dry in the main horticultural areas. Those with irrigation prospered and had excellent crops.
- there have been few storages built in past year except for a few potatoes and carrots
- the greenhouse industry continues to expand frantically, particularly in the Leamington area (cucumbers and tomatoes) and in Niagara (flowers)
- non-traditional niche-market crops are being grown with unfamiliar post-harvest requirements

Grains and Forages:

- construction of tower silos remains at an all time low
- silo deterioration continues to be an ongoing challenge
- plastic from wraps, tubes, individual bags, etc. present local problems for recycling or disposal

Building Engineering:

- building construction is relatively active in Ontario. Typically, new livestock buildings are tending to be very large. Engineering is more prevalent in these larger structures. A larger contractor may have an on-staff engineer or may hire a private consultant to provide engineering details. Building officials are happy to share some of the responsibility for the structure with an engineer.
- municipal restructuring will eventually result in fewer, better trained building officials. There were over 800 municipalities in Ontario; we're down to 500+ right now and expect to be in the range of 350 by 2003. This will bring about more even application of building codes in Ontario. OMAFRA is battling irregular application of building codes.

Environmental:

- while slightly down from last year, a large number of swine, poultry and dairy operations are still being constructed in Ontario. Two large swine facilities were found to be leaking manure into field tiles that were left directly below the structures during construction.
- odours from mushroom composting operations may prove to be the industry's downfall. One case currently in the courts is considering damages to neighbours whose property rights have been infringed upon.

EMERGING ISSUES:

- preventing manure leakage from barns and storages
- challenges of perception regarding on-farm antimicrobial resistance
- manure handling problems when sanding bedding is used in free-stalls
- power driven nails do not have the shear strength or holding power of spiral and common nails.
- increase in tarp type buildings for hay storage and cattle housing
- management of deep (7-8') bedded manure pack beef barns

- interest in 'greenhouse' barns for calves, heifers and free stall barns continues
- corrosion of farm building components
- animal care and comfort: base and bedding, feed barriers, stall designs, and flooring
- use of cow mattresses: rubber filled; heavy sponge-rubber (concerns with stretch)
- interest in full curtain walls for dairy; usually a split wall design where the top part is not insulated and the bottom portion is insulated
- wider, single storey poultry barn are challenging conventional ventilation systems
- air quality in swine barns: health of workers; high manure gas levels during agitation
- poultry producers are considering the installation of foggers and/or misters to achieve some evaporative cooling
- disease control on new large swine operations
- covered manure storages for poultry
- more cold storages will be used year round to spread out costs. This may create some vapour barrier problems with reversing vapour pressure gradients
- aeration systems for flat grain storages
- producers believe there is a need for research to provide information and technology to prevent or alleviate concerns regarding animal welfare and environmental sustainability in all sectors.
- question the typical design of knee-braced joints for shear loading
- questions still remain regarding the use/operation of tunnel ventilation systems
- animal care and welfare issues are becoming more common
- barn air quality is still an issue
- what depth of manure storage under a barn floor is acceptable?
- what is the real value or importance of insulation under the floor of a poultry barn?
- what effect or impact will the Y2000 date problem have on livestock buildings and equipment, eg. feeding, ventilation/heating
- time commitment, and type of cleaning equipment being recommended for cleaning barns between animal cycles. There is some speculation on the use of robotics for this task
- Corrosion of farm building components continues to be a problem
- Need to design manure tanks for ice pressure

New Ideas for Research and Service:

- Require information regarding the strength of nailed joints
- Require information regarding the factors that affect tunnel ventilation
- Require information regarding the effectiveness of floor insulation
- Require information regarding the effectiveness of various heating systems for "the same" animal comfort (specifically in SEW swine barns)
- Would like to have increased fan and controls testing by an independent testing agency
- Require increased odor control research for both inside barn air quality as well as around the buildings
- Committee members felt that the agricultural sector needs to become more proactive in the environment area. Recommends this committee pass on this comment to the Rural Environment Committee

- would like to see Canada Plan Service concept drawings, but not engineering design information
- would use Canada Plan Service for technology transfer and sharing new concepts
- ventilation information and details would be useful, as would manure handling info
- beef producers need to be able to lower costs of production by 20%. Simplified structures would assist. Some features might be modular construction, a roll-off roof, combination manure systems
- there are a few cases of human tapeworm disease in beef cattle. HACCP programs should consider this type of problem.

4.2 FOOD ENGINEERING

MAJOR ACCOMPLISHMENTS SINCE LAST REPORT

- Mr. Hugh W. Fraser (OMAFRA) worked on a CanAdapt project "Controlled ripening and reduced ethylene effects in horticultural crops using novel ethylene antagonists". Highlights are: (i) Ethylene speeds up senescence of many horticultural crops with a resulting decrease in shelf life. (ii) Ethylene improves quality of bananas and tomatoes by promoting faster more uniform ripening before distribution. (iii) Ethylene is produced whenever organic materials are stressed, oxidized, or combusted. (iv) Ethylene causes premature yellowing of produce such as spinach, broccoli, parsley, cucumbers, and causes damage to most floral commodities. To date, the horticultural industry has already made changes based on his findings. Subtle changes in management could save the industry millions of dollar annually.

- Mr. Hugh W. Fraser (OMAFRA) also worked on a CanAdapt project "Time/temperature in head lettuce handling". There may be some potential for using *Visual Non-Reversible Time-Temperature Indicator Technology*, but only as an internal quality control check on handling procedures, not for pointing blame for temperature control problems throughout the system.

- Edible coating/film to produce low fat fried foods by Dr. G.S. Mittal's group (UOG): Fat absorption in fried foods was reduced by 90% using selective edible coating/film. Extensive modelling work was done to get optimum transport properties of the film/coating for minimum fat transfer and optimum water migration for better crust formation in low-fat fried foods. In another study, a soy protein film coating was developed and evaluated to reduce fat transfer in deep fried foods during frying. Soy protein isolate solutions (10% SPI) with 0.05% gallon gum as plasticizer cooled after being held at 80°C for 20 min provided suitable films. There was a significant fat reduction (55.12%±6.03%db) between fried uncoated and coated discs of doughnut mix. The same films were used on potato fries. Some panellists observed a slight difference between the coated and uncoated fries but many preferred the coated fries over the uncoated ones. Penetration test on potato fries showed no significant difference between the texture of coated (SPI with gallon gum) and the uncoated fried samples. A solution of 10% SPI with 0.05% gallon gum is recommended for coating foods to reduce fat intake during deep-fat frying.

- Food pasteurization using electric pulses by Dr. G.S. Mittal's group (UOG): A unique process that uses pulsed electrical field to preserve liquid and semi-liquid foods has been developed. Many break-throughs at Guelph made this process suitable for commercialization, and placed us at the forefront worldwide in this area. The University has filed for a US patent on "pulsed electric field pasteurization" in August 1998.

- Neural network for process design by Dr. G.S. Mittal's group (UOG): A neural network was successfully developed to design complex thermal processing of packaged foods for safety and quality. Other neural networks developed for food process design are: (i) freezing process design for different shaped foods, (ii) psychrometric predictor for air properties, (iii) predicting heat and mass transfer during smokehouse cooking of frankfurters, and (iv) temperature, fat and moisture changes during deep-fat frying of slab shaped food products coated with edible coatings.

- Dr. V. Davidson's (SOE) research is related with computer-based process control and decision-support in food processing. Research supported by the OMAFRA Foods program ("Software and Sensors for improved control of food processing") extended the fuzzy inferencing techniques to automated inspection of food products. Funding for this research was also obtained from Materials and Manufacturing Ontario (MMO), and supported by Dipix Technologies Inc. (Ottawa-based manufacturer of Qualivision™ systems) and Nabisco Brands Inc. (Peek Frean Bakery, East York).

Publications and Presentations
Papers in refereed Journals

Mittal, G.S. and Zhang, J. 1999. Vibration responses of wheat dough. Int. J. Food Properties 2(3):243-253.

Williams, R. and Mittal, G.S. 1999. Low-fat fried foods with edible coatings -- modelling and simulation. J. Food Sci. 64:317-322.

Correia, L.R. and Mittal, G.S. 1999. Food rheological studies using coaxial rotational and capillary extrusion rheometers. Int. J. Food Properties 2(2):139-150.

Ju, J. and Mittal, G.S. 1999. Effects of fat-substitutes, fat levels and cooking methods on the quality of beef patties. J. Food Processing and Preservation 23:87-107.

Mittal, G.S. 1999. Mass diffusivity of food products. Food Review Int. 15(1):19-66.

Kajuna, S.T.A.R., Mittal, G.S. and Bilanski, W.K. 1998. Mechanical properties of plantains by vibrational method. Int. J. Food Properties 1(3):207-220.

Conference Proceedings/Presentations

Mittal, G.S. and Zhang, J. 1999. Vibrational characteristics of Cheddar and Mozzarella cheeses at various fat and moisture contents for in-line process monitoring and control. Paper No. 99-3024, Amer. Soc. Agric. Eng., St. Joseph, MI.

Mittal, G.S. and Zhang, J. 1999. Artificial neural network development for predicting freezing time of various shapes foods. Paper No. 99-3132, Amer. Soc. Agric. Eng., St. Joseph, MI.

Mittal, G.S. 1998. Liquid food pasteurization using low energy electrical pulses. Int. Agric. Eng. Conf., AIT, Bangkok, Thailand.

Factsheets (available from OMAFRA in English and French)

Fraser, H.W. and Chaput, J. 1999. Long-term storage of carrots #98-073, p6, OMAFRA.

CURRENT STATE OF THE INDUSTRY

Down-sizing and consolidation of Canadian and U.S. operations continue to impact the structure of many Ontario food processing companies. Due to regional and global trade agreements, the food industry in Ontario is facing **international competition**. This will require considerable readjustment, productivity improvement and enhancement in product quality and safety. There is a large emphasis on value-added aspect of food processing. Downsizing putting less emphasis on R & D and more on organization aspects. Resources in Engineering R & D are decreasing due to overhead cuts and profit oriented approach. Food engineers are leaving to other industries and consulting due to less job satisfaction.

Less competition is being created due to merging as the number of owners are decreasing in each food sector. On the other hand, **Co-packing** is increasing where smaller food processors are processing foods for larger processors. This is creating number of smaller processors and lower wages jobs. Many small companies are producing specialized food products. Ethnic group food companies are also emerging to supply special food items to various communities.

Education and training of workforce to properly use modern technology is lacking in food industry compared to other industries such as automobile industry. Due to the use of newer technology a wide gap is created between technology and training of workers.

Nutritional issues are important for the industry. **Nutraceuticals** are also being produced in Ontario, but progress is slow. Overall, Canada is behind USA in this respect. In fortification of food products, juices in particular, USA is leading due to advantages in regulations. Chemical analysis of nutraceuticals are needed as well as improved labelling regulations are required.

Economic problems: For export, Canadian processed food is more attractive due to low value of Canadian dollar. However, imported equipment, machinery and raw material are more costly.

Energy managements are needed by process and equipment modifications to reduce processing cost.

EMERGING ISSUES

Safety and Quality: Air quality in the plants is required to be maintained particularly where

ovens are used. Water quality for food processing is also becoming more critical. Effective use of water and reuse of waste water are needed. Sensors for quality attributes and food safety are needed to effectively produce products with consistently high quality and greater consumer acceptance. For this, rapid and in-line methods for food analysis and quality control are required.

Technological Challenge: Computer-dependant technologies continue to be important within the industry. Advances in instrumentation, automation and software, vision systems, and wider implementation of HACCP related quality control systems are all leading to wider use of computer technology. Vision scan and x-ray devices are needed for bruise detection on fresh produce, proper baking of cookies, and detection of worms and blood spots in food products.

Neutraceutical Processing: There seems to be interest in extracting neutraceuticals from soybean, tomato, hemp, etc. Appropriate separation technology is needed to extract active ingredients. Cold processing is required to avoid degradation of active ingredients. Research is also needed in purification and concentration of neutraceuticals.

Wine industry: Due to the growth of wine industry in Ontario, there are research needs in process engineering area.

Byproduct Utilization: Presently byproducts from many food industries are going for animal feeding. Research is needed to utilize the byproducts from corn, apple and grape processing industry.

4.3 RURAL ENVIRONMENT ENGINEERING

MAJOR ACCOMPLISHMENT SINCE LAST REPORT

.1 Publications, Factsheets, Manuals

Private Water Well Omners – Dealing With Water Shortages, Factsheet, Jim Myslik, OMAFRA

Hazardous Gases, Factsheet, Luc Brunet, OMAFRA

How To Prepare For Irrigation During Water Shortages, Factsheet, Jim Myslik, OMAFRA

Best Management Practices – Integrated Pest Management ***Blue Ribbon Award Winner CSAE ****
Milking Centre Washwater Disposal Manual, Bob Stone, OMAFRA

Oil and Gas Exploration, Production and Legislation On Ontario Farms, Petroleum

Resources Centre, MNR and OMAFRA.

.2 Educational Courses

Primary Drainage Contractors Course, Feb. 2 - Feb.11, 1999
Advanced Drainage Contractors Course, Feb. 22- March 4, 1999
Municipal Officials Drainage Course - Apr. 1999
Concrete Manure Storage Design Course, 1999
Custom Manure Application Course, 1999
Pollution Control Course, 1999
Drainage Superintendents Course, 1999
Nutrient Management Sessions - 1999 (several)
Ontario Environmental Farm Plan - 1999 All Ontario.

.3 Reports, Periodicals, Articles

Interim Report - 1998 - By : Claude Weil, Doug Joy, and Chris Kinsley. Establishment of Centres for On-site Wastewater Treatment

Final Report - 1998 - Sarah Hurd, Anna Crolla and Claude Weil. Ferme Vachalê Constructed Wetland

Dignard Artificial Wetland - 1998 - Olivier Fankhauser and Claude Weil. Year 3 of Operation, 1997-year end report

Cost-Benefit Analysis for a Constructed Wetland in Eastern Ontario, Canada, by : Pierre-Alain Blais and Claude Weil, Annual Northeast Agricultural and Biological Engineering Conference (NABEC, 1998).

Article in Agri-food Research in Ontario
Spring 1998 Vol.21 no.1 - Reducing water and Energy use in the first step to Expanding production in poultry abattoirs.

.4 Other

Ontario Rural Wastewater Centre, University of Guelph School of Engineering and Alfred College.

CURRENT STATE OF THE INDUSTRY/RURAL SECTOR

Soil, water, and air issues related to large livestock operations continue to dominate the agricultural

industry. The primary stimulation is the construction of swine barns. The number of large swine and dairy operations are still on the increase . More and more municipalities are passing bylaws to try and control construction in an orderly fashion. Nutrient management plans, days of manure storage, and MDS II requirements are included in most bylaws. Variations occur when attempts are made to inventory land used for application of manure and guarantee application rates. Local resident organizations are still very vocal and well organized in presenting their concerns and demands. Municipalities are reacting accordingly.

Much attention is still focussed on nitrates as the primary contaminant but bacteria is getting more and more attention. Runoff from agricultural lands is being scrutinized from many fronts. Department of Fisheries and Oceans and Environment Canada are now getting involved more directly with situations that may be impacting fisheries in Ontario ie. two incidents in Eastern Ontario where charges have been laid. Demands to protect and create riparian zones along waterways and wetlands is also still on the rise.

Phosphorous loading on streams is still a primary concern in many areas of the province. Many municipal treatment systems are dependent on rivers to assimilate treated waste water from cities and towns. Assimilative capacities of some rivers have reached or are reaching the maximum levels permitted . Municipalities are searching for cost effective alternatives such as "phosphorous trading" or "phosphorous credit" type accounting systems based on improvements to agricultural land and nutrient management techniques. Waterloo region has successfully implemented a financial incentive program in targeted areas to encourage implementation of BMP's in agricultural areas. Wellington County is in the process of initiating a similar program bases on the Waterloo model. Other areas (Lake Simcoe, South Nations etc.) are in the process of also initiating similar programs. The problem still remains as to how to account for water quality improvements (phosphorous) which are hard to measure or take time to appear. Empirical and modelling methods are being developed for the purpose of accounting water quality gains.
The Environmental Farm Plan process went through its sixth full year of operation and distributed close to 2500 workbooks which is consistent with previous years. Funding for the next two years has been attained and will be in place. The target for the coming year is again to process 2000 workbooks. The incentive program which provides $1500 towards improvements identified in the Farm Plan is being well used and on the increase. The Rural Water Quality Program in Waterloo implemented a completed Environmental Farm Plan as a requirement of eligibility for the program as has the Wellington County program.

Activity in the tile drainage industry increased again in the 1998/1999 season. From a survey conducted of manufacturers of agricultural tile, approximately 152 million feet of tile was sold for agricultural purposes in 1998. This is the highest quantity sold in the 1990's. From 1990 to 1995, the annual quantity of tile sold ranged from 53 to 89 million feet. This increased in 1996 to 107 million feet and rose again in 1997 to 139 million. There were $8.6 million in loans issued to landowners through the Tile Loan Program 1998/99. This is a decrease from the $9.3 million issued in the 1997/98 fiscal year.

In 1998, there were 114 drainage businesses, 455 operators, and 189 machines licensed in the province under the *Agricultural Tile Drainage Installation Act*. Drainage tubing prices remain stabile and are not expected to change much. There was a substantial demand for training of contractors in order to obtain operator licenses (100% increase).

The amount of small diameter tile installed is unknown but is estimated to be well over a million feet. Most of which is self installed by land owner using mini-tilers. It is estimated that there are well over 160 mini-tiler machines in Ontario. To date, there is only one machine licensed for commercial use under the *Agricultural Tile Drainage Installation Act*.

In the 1998/99 fiscal year, the total expenditures by the municipal governments authorized by the *Drainage Act* was $24.9 million (8% increase from previous year). New reports from engineers represented 340 projects with a total cost of $17.9 million (8% increase from previous year). A total of 1678 drain maintenance projects were reported on with a total cost of $4.5 million. The municipal drainage superintendent costs totalled $2.48 million. This combined total of $6.98 million is a 7% increase from the previous year).

The Department of Fisheries and Oceans, in consultation with stakeholders, has developed a Class Authorization system for the maintenance and repair of existing municipal drains. They, in partnership with local Conservation Authorities, have funded the collection of data to catalogue the fish habitat that currently exists in municipal drains. This information is used to classify each municipal drain into six different categories. As a result, municipal drainage superintendents will be able to receive a "class authorization" for their proposed work, provided they follow the predefined conditions for that drain. This positive development promises to minimize the frequent conflicts between municipalities and environmental agencies in the maintenance and repair of existing municipal drains.

The province has recently announced a review of their drainage programs. This review will be initiated in early 2000 with results announced later in that year.

EMERGING ISSUES

Municipal Bylaws to Control Development of Large Livestock Operations

Large livestock operations are still on the rise in Ontario. Municipalities are reacting to the concerns of the public at large as well as reacting to bylaws instituted in neighbouring municipalities with the view that if neighbouring bylaws are more restrictive swine barn will move to those areas with less control. Municipalities have been given more responsibilities and power. Some are making full use of it. OFEC released a position paper on bylaw development which has helped to reduce the variability between municipalities but with limited success too date. Bylaws are replacing moratoriums on construction. Nutrient management plans are required in all the new bylaws along with MDS II and minimum storage requirements. Other variables that are being introduced are inventory of land used for manure spreading, verification of application rate, minimum acreage owned, registration of land to be used for manure application etc. Municipalities are searching for

mechanisms to give them more control over the situation.

Community Resentment Towards the Establishment of Large Swine Operations
Resentment towards the construction of large swine producing facilities continue to escalate. Guarantees of no odours, no ground water contamination, and no surface water contamination are being demanded. Rural residents who may not even be adjacent to or near the construction sites get actively involved. Some situations are even proceeding through the courts to challenge the construction and operation of larger swine barns.

Continued Rise in Public Scrutiny and Interest in Non-traditional Components of Water Pollution.
Water quantity and quality issues are stimulating people to become more aware of other types of water pollution such as Cryptosporidium, giardia, residual medicines and hormones etc.. As their knowledge base increases so does their suspicions of what else might be out there that could be harmful and/or persistent. In many cases there is a link to agriculture. Housing is on the increase once again across much of the province and is putting increased demands on sewage treatment plants and the assimilative capabilities of receiving waters. Technology is not available or affordable to reduce phosphorous levels further necessitating a search for other methods to deal with the situation. Phosphorous is the key component. If Phosphorous levels in the river can be reduced ie. BMP practices by agriculture, present waste treatment technology can still be used (less costly). Another approach that is being looked at is look at the possibility of increasing river flow. Is their waste in the use of water or is too much water being used upstream ie. Irrigation. These are both major issues for the farm community to face and the pressures will increase as more municipalities face waste treatment expansion and upgrades. Presently, there are four watersheds actively involved in this approach and many more will are forthcoming.

Draught Conditions in Western Ontario is Stimulating Discussions on Water Rights and Allocation.
The general public is used to an abundance of clean surface and ground water. As these supplies get taxed as they have been this summer, sudden attention is given to how the water is used and who has first rights to it. In some areas, this has been the second year and there were conflicts related to supply and use. A Drought Task Force has been initiated by the Province to address the situation and draft a plan that can be used in year 2000 should the low waters levels continue.

Drainage Looked at as Contributor to Low Flow Rates in Streams.
In the past, drainage has been accused of increasing peak flows in channels. Now it is being looked as a contributor to low flows in dry periods. The focus is on base flow reductions and reduced ground water recharge.

Methane - Greenhouse Gas from manure.
As more and more manure is spread on the land, methane is emitted into the atmosphere which threatens the ozone layer. As people look for more reasons why livestock's agriculture should not

expand, greenhouse affect could be the next front to deal with. Research is already started in Ottawa.

Vegetable Wash Water Quality and Legislation
Concerns have been raised regarding fruit and vegetable wash water and how it is handled. Applying the legislation as it is in place could have serious economic impacts.

Livestock Access to Streams and Conflict with Fisheries Act
The private sectors are searching for new mechanisms to meet their expectations of stream water quality. Complaints have been lodged under the Fisheries Act which is federal jurisdiction and charges have been laid. This is an indication that the public is not satisfied with provincial response to complaints of this nature. Under the Fisheries Act it is much easier to verify a charge.

Irrigation Water Quality and Food Safety
Irrigation water quality and food safety is an issue of the future. Limited situations have been encountered in Ontario ie. apple cider contamination. It is a rising issue in the US and is likely to be more important here in Ontario especially with fresh produce and quality of irrigation water that is used.

Nutrient Management Bylaw and Plan Court Challenge
Even though nutrient management planning and bylaws are still in their infancy stages in terms of development, the public is not trusting and in their desire for greater environmental security have challenged the nutrient management approach in the courts. Interest is high from both sides of the issue and could greatly influence the future depending on the ruling.

Impacts of weather to runoff and infiltration.
1999 was another dry year in approximately six locations in the province. Agriculture, urban water supplies, sewage treatment facilities, private water supplies, recreation, power generation, ecological systems were all affected. Reserves are very low. Problems and conflicts are probable for the coming year unless there is an unexpected turn around in the weather patterns. In some areas, it is projected that it will take 3 to 5 years of normal precipitation to get back to normal. Long term impacts have not yet been determined.

5.0 REPORT OF ACTION TAKEN ON PREVIOUS RECOMMENDATIONS:

5.1 LIVESTOCK ENGINEERING

Responses from ARIO; OMAFRA; AAFC; Others:
Improvement of air quality in and around livestock buildings will help to improve the health and well being of both livestock and farmers as well as improving the acceptance of livestock operations in the community.

The dairy pork and poultry components of the animal program at the University of Guelph contain objectives related to improving the internal building environment. The new Agri-Food System Resources and Environment program supports research into manure handling systems which may also serve to improve the internal environment.

Maintenance of the structural integrity of farm buildings is an important component of ensuring the health and safety of farmers and livestock. Resources at present do not allow for extensive research in this area and ARIO continues to suggest that private sector partners be sought to assist with the required research and extension.

AIR QUALITY IN LIVESTOCK BUILDINGS.

Response: University of Guelph – The only project in the Animal program of the University of Guelph/OMAFRA Enhanced Partnership that addresses this priority is: Amelioration of odours from hog manure by electrochemical treatment. N. Bunce
There are animal scientists co-operating with systems projects in the Resources program who are addressing this priority.

Corrosion and deterioration of agricultural building components.
No Response.

5.2 FOOD ENGINEERING

ARIO Response to Food Engineering Recommendations

ARIO recognizes the research priorities contained in the recommendations presented by the Food Engineering subcommittee. Work to address these priorities is supported in the Food and other programs that are part of the Enhanced Partnership with the University of Guelph. Research into food processing has also been supported through the Special Research and other competitive research programs. These research priorities will also be taken into consideration during the review of the Food program next year.

The limited human and financial resources available dictate that all priorities can not be addressed

simultaneously. In order to address new issues or expand work in existing priorities research in existing areas must be either scaled back or completed to make the resources available. OASCC committees can assist in this process by identifying research areas which are no longer high priority.

A mechanism is being put in place to redirect resources within the Enhanced Partnership Agreement to high priority areas which are not being adequately addressed. Committees will need to identify which areas are the highest priority and also which areas can be scaled back.

The move of Agriculture and Agri-Food Canada researchers from Ottawa to Guelph will provide further opportunities for increased collaboration between the University of Guelph and federal researchers allowing more efficient use of resources.

Sub-Committee Response:
This year there was no response for each priority, but only general comments were given. The Food Engineering sub-committee was not happy as in the last 4 years, not much work was supported in the recommended areas. It is frustrating that after spending considerable time by the sub-committee members in developing these priority no action was taken.

In previous years the recommendations of this sub-committee were grouped under various areas. Due to this, OMAFRA might have ignored the projects listed under the different areas. This year sub-committee is providing recommendations project-wise so that none of the recommendations are ignored.

Not much work has been done on many past recommendations. Therefore some projects are being recommended again.

Since food industry is the second largest industrial sector in Ontario, and food industry is facing many engineering related problems, more resources are needed for food engineering research.

5.3 RURAL ENVIRONMENT ENGINEERING

ARIO Response to Agricultural Engineering Recommendations

ARIO recognizes the research priorities which have been identified in the recommendations presented by the Agricultural Engineering Research and Services committee and its subcommittees.

Rural and Crop Engineering

Priority areas such as manure management, site specific farming, emissions, and water management can be addressed through the Agri-Food System Resources and Environment program at the University of Guelph. In addition, research is also supported in plants and animal programs.

In April, the University of Guelph presented the new Agri-Food System Resources and Environment program to ARIO. This research program will cover from 1999-2003 and combines the resources and mandates of the former Agri-Food Systems and Environment and Natural Resources research program. The new program will allow for research into the biophysical, economic and social implications of resource management issues confronting the agri-food sector in Ontario. Research will focus on the management of biophysical and socio-economic resources to ensure a competitive agri-food sector while enhancing and preserving the environment.

The Agri-Food System Resources and Environment program has been developed and refined over the past two years through a series of consultations which included OASCC committees, OMAFRA, AAFC and faculty at the University of Guelph.

The program utilizes an issues based structure similar to that of the Environment and Natural Resources program which it replaces. It has been structured around 6 objectives corresponding to a biophysical or socio-economic resource and goals which outline a long term requirement for research (greater than 4 years). The objectives and goals will be re-evaluated every 4 years as part of the program review.

In order to address these objectives and goals, a set of research issues have been identified which will contribute to the long term requirements. The issues listed are in response to the identified needs for urgent information put forward by the OASCC committees including the Agricultural Engineering committee. Research conducted on these issues will be expected to contribute to the overall objectives and goals of the program. Each issue has short term (4 years) desired outcomes listed.

The program proposal as presented to ARIO addresses research priorities brought forward by the sub-committees. Project selection for the new program is currently underway. Once the projects have been finalized a document summarizing deliverables for each issue will be distributed.

A copy of the program proposal has been attached for your information. Details of the program can be obtained from the program director, Dr. Michael Goss. The program proposal is also available from the University's website at: http://www.uoguelph.ca/research/omafra/documents/afsre.pdf

The limited financial and human resources available dictate that not all priorities can be addressed simultaneously. In order for new priorities to be addressed, or emphasis shifted, existing research must be scaled back or completed so that the resources can be reallocated.

A mechanism is being put in place to redirect resources within the Enhanced Partnership Agreement to high priority areas which are not currently being adequately addressed. Committees will need to identify areas which are the highest priority and also which areas of research can be reduced.

Service recommendations do not fall within the mandate of ARIO. The service recommendations included in this year's report which were addressed to ARIO have been forwarded to the Agriculture and Rural Division of OMAFRA for response.

INVESTIGATE METHODS TO TREAT LIVESTOCK MANURE TO REDUCE ODOURS.

AAFC Response:
Several studies are in progress in the US, Europe and Canada on effective odour control, in animal production operations. Some of the Canadian studies are under the HEMS program. A key input requirement is economic feasibility of proposed odour control methods. Not all studies appear to include economic assessment of the proposed technology. The US Pork Council commissioned a study (in ca. 1995) of published information on odour control from animal operations. An international conference on control of ammonia and odour was held in the Netherlands in 1997. It is understood that the American Society of Agricultural Engineers will have a meeting in 2000 relating to this topic. In investigating methods relating to odour control, it is necessary to be cognizant that while odour is controlled, the problem is not shifted from pollution of air by odour to other environmental areas, e.g. release of ammonia into the air (by aeration), increased nitrate loading on soil from treated manure, increased greenhouse gas release (nitrous oxide). A proper balance is required to ensure least impact on the total environment. Details of this recommendation are related to appropriate research centres for consideration vis-a-vis their research programs.

TO DEVELOP IMPROVED SYSTEMS FOR APPLYING MANURE TO THE LAND MORE ACCURATELY, COST EFFECTIVELY, AND WITH FEWER ODOURS.

AAFC Response:
SCPFRC has recently initiated a 3-year project in partnership with Ontario Pork, the Agricultural Adaptation Council, and Nuhn industries to investigate swine manure storage and application methods which conserve nutrients, protect the environment from chemical or biological contaminants, and benefit crop yield through suppression of soil-borne diseases. A precision "Manure research Unit" liquid manure applicator has been built by Nuhn industries and will be used to investigate manure application methods on site-specific crop yield.
ECORC -

TO EVALUATE AND QUANTIFY THE IMPACT OF LARGE LIVESTOCK OPERATIONS ON THE RURAL ENVIRONMENT.

AAFC Response:
In connection with the proposal, it is noteworthy that a similar study was reported on at the HEMS meeting in Toronto in April 1998. The information is in the HEMS Proceedings. Another study on community acceptance of large livestock operations is in progress in Manitoba, with the involvement of Manitoba Agriculture. A conference on siting of large livestock operations (Canadian Agri-Food Research Council) was held in Ottawa several years ago and Proceedings are available. The Brandon Research Centre (R.G. Eilers and K. Buckley) and the Prairie Farm Rehabilitation Administration (in Regina) is involved in a prairie-wide joint (co-managed) project entitled "A methodology to evaluate land suitability for the application of hog manure". There was a paper presented at the 42nd Annual Manitoba Society of Soil Science Meeting, February 2-3, 1999. This latter study does not deal directly with odours, but there may be some indirect effects. It may be useful to assess the

findings and recommendations of these studies vis-a-vis the proposed comprehensive study. Details of this recommendation are related to appropriate research centres for consideration vis-a-vis their research programs.

MOE Response
This recommended research priority is relevant to environmental protection issues and is timely to deal with pressures from the development of large livestock operations in Ontario. Especially, proper guidelines or consistent rules need to be developed so that the location and management of facilities can be based on key relevant issues.

The proposed items for the study do not include possible impacts on surface waters in conjunction with possible impacts on groundwater supplies and their volumes. It is recommended that this be taken into consideration.

Recommended under high priority. This comprehensive study should be completed in conjunction with the Nutrient management plans and relevant findings. There are other research priorities listed such as III-1.4-B and recommendation 1-3 (Issue: Manure Management from the Soil, Water and Air Research and Services committee) that have some relationship to this research priority. Some explicit priority to priority study ties or working framework need to be established. Consider the need to assess impacts on groundwater supplies.

TO IDENTIFY SOURCES OF WATER CONTAMINATION IN AGRICULTURAL WATERSHEDS AND PUT INTO PERSPECTIVE THE VARIOUS CONTRIBUTORS.

GPCRC Response:
Effects of fertilization and crop rotation on soil quality, crop productivity, greenhouse gas (CO_2 and N_20) emissions and water quality are being investigated. Plots established in 1959 which allow for baseline nitrate and P leaching studies are being used in a cooperative study with University of Guelph for the nitrate modelling component.

SCPFRC Response :
The possible movement and endocrine-disrupting effects on fish of estrogenic hormones from fields receiving manure is being evaluated on two swine farms and one dairy farm.

MOE Response :
This is a critical priority for the big picture. It is typically addressed through partnership efforts based on watershed management approaches dealing with strategic issues of environmental protection and conservation and resource management. Considerable evolution of approaches and knowledge in this field has been accomplished in watersheds such as Grand River, Lake Simcoe and Bay of Quinte. However, not all issues are generic to all areas. They are also site or area specific. In some Ontario watersheds these approaches have recently evolved to comprehensive point and non-point source assessments and recommendations for management programs. As noted in the proposal, past initiatives dealt mostly with some of the issues.

We have concern that only nitrate-N was indicated for nutrients; other nitrogen forms or even phosphorous were left out.

This is high priority research. Perhaps it needs better defined focus and specific "big picture" setting advancing our knowledge in some of the noted watershed initiatives underway or potentially including additional work on the Maitland Ecosystem Health Project.

Consider research into the enhancement of agricultural drains for improved wildlife and aquatic habitat. Why put clean water into drains if there is no habitat for wildlife or fish? The comprehensive study should also look into the practice of tile field drainage with respect to both water quality and quantity impacts. In addition, consider the impacts of farm practices in the use of biosolids (sewage and paper mill) - this links with a later issue - biosolids/waste application and treatment (from OSWASRC). Further consider the need for a comprehensive study to examine all sources of contamination. Fertilizer and pesticide runoff into surface and groundwater should be incorporated into this study based on normal agricultural and non-agricultural use practices and not just as a result of spills.

TO ASSESS AND ESTABLISH AGRICULTURE'S BASELINE NEEDS FOR DRAINAGE, WATER SUPPLY, NUTRIENT USE IN ORDER TO FIND AN EQUITABLE BALANCE WITH OTHER USES OF THE RURAL ENVIRONMENT SUCH AS FISHERIES, WILDLIFE, AND NATURAL HABITAT.

PGCRC Response:
Several studies are currently underway to determine and improve nutrient management requirements for field crops. Examples include effects of tillage systems and cover crops on soil quality, crop productivity and greenhouse gas emission; effects of fall and spring tillage systems on soil quality and crop productivity, short and long-term effects of no-till, conventional till and ridge till on crop productivity and nutrient demands; effects of compost source on soil quality and crop productivity; effect of fertilization and crop rotation on crop productivity and; development of new N mineralization soil tests for Ontario to improve nutrient management

TO EVALUATE THE APPLICATION OF NATURAL CHANNEL DESIGN SYSTEMS TO MUNICIPAL DRAINS IN AGRICULTURAL ONTARIO AND TO INVESTIGATE INEXPENSIVE METHODS OF ADAPTING NATURAL CHANNEL DESIGN TECHNIQUES TO EXISTING MUNICIPAL DRAINS.

Response: None

TO ASSESS NON-CONVENTIONAL FORMS OF WATER MANAGEMENT WITH THE FOCUS ON GROUND AND SURFACE WATER TREATMENT SYSTEMS.

GPCRC Response:
Effects of controlled drainage and controlled drainage/subirrigation and N rate on corn and soybean

production and water quality (herbicides and nitrates) is being evaluated in specific plot work and on two demonstration farms on coarse and fine soils. This controlled drainage system is an effective way to reduce nutrient and herbicide contamination.

EFFECTIVENESS OF ENGINEERING RELATED MANAGEMENT PRACTICES FOR THE PROTECTION OF WATER QUALITY.

GPCRC Response:
The hydraulic and aeration characteristics of soil under native forest, no-tillage and clay loam soils is being studied to determine the extent to which annual cropping has degraded these properties and to obtain information on how these characteristics might be improved in annually cropped soils.

ECORC Response :
The pore system and aeration properties of soil under best and worst management systems are being studied to determine how the timing of field operations affects soil properties and ultimately crop yields.

MANURE APPLICATION FOR CONSERVATION TILLAGE SYSTEMS.

GPCRC Response:
A new study was initiated this year in cooperation with private industry and the University of Guelph to determine impacts, ideal rate of application, interaction with crop nutrient cycling, decomposition rates and effect on soil quality of various composts including livestock manure. Parameters measured will include crop yield, soil fertility, soil organic matter, soil physical quality, water storage and water transmission parameters, crop root growth and soil structure.

SCPFRC Response :
Optimum application rates and timing of side dressing liquid swine manure on field crop production is being evaluated on a site-specific basis.

6.0 STRATEGIC DIRECTIONS/PROBLEMS OR ISSUES/SECTOR PRIORITIES

6.1 LIVESTOCK ENGINEERING

RECOMMENDATION NUMBER 1

LIVESTOCK BUILDING DESIGN, CONSTRUCTION and HUSBANDRY SYSTEMS RELATIONSHIP TO ANTIMICROBIAL RESISTANCE, HUMAN and ANIMAL HEALTH

The use of antibiotics in animal production has been linked to the development of antimicrobial resistant bacteria that cause disease and death in humans. To protect human health, authorities in Denmark and Sweden banned the use of antibiotics for disease prophylaxis and growth promotion in animals. However, the same officials strongly recommended correcting the deficiencies in housing and husbandry systems before banning the subtherapeutic use of antibiotics. Corrections to housing and husbandry are critical first steps to avoid sickness, death, compromised animal welfare, and lost productivity in livestock farming without subtherapeutic antibiotics.

The antimicrobial resistance - human health issue is here. It will drive the banning of antibiotic growth promoting products from farming practices in Canada sooner than most might expect. Livestock producers need to know what renovations to make to existing animal husbandry units and what features to build into new units to prepare for the inevitable ban.

Research is needed:

1. To identify the design, construction and husbandry systems in livestock buildings that compliment high livestock health and performance without the use of antibiotic growth promotants or the subtherapeutic use of antibiotics. (Conversely, to identify the design, construction and husbandry systems that contribute to disease and impaired performance that require the use of subtherapeutic antibiotics.)
2. To develop practical and economical designs and construction methods for renovating existing buildings or building new structures to enable high livestock health and performance.
3. To develop practical and economical modifications to existing husbandry systems or create new husbandry systems within livestock buildings to enable high livestock health and performance.
4. To identify design, construction and husbandry systems that minimize disease transmission. (Conversely, to identify design, construction and husbandry systems that contribute to the spread of infectious diseases.)
5. To develop practical and economical design, construction and husbandry systems that minimize disease transmission.

Funding is needed:

1. To create a centre for livestock husbandry planning to enable dialogue between scientists in the disciplines of engineering, waste management, nutrition, veterinary medicine, economics, and human medicine (to name a few) directed at livestock housing systems, animal and human health, and the reduction of the use of antimicrobial products.
2. To enable the creation and implementation of a national strategy focused on livestock buildings and husbandry systems to reduce the use of subtherapeutic antibiotics.
3. To enable the development of national standards in housing, construction and husbandry systems focused directly at ensuring high livestock health and performance without the use of subtherapeutic use of antibiotics.
4. To enable validation of the above mentioned national standards on Canadian farms.
5. To enable the inclusion into codes of national standards that foster the reduction of antibiotic use and the enhancement of livestock health (into building codes for livestock structures and codes of practice for animal care).

RECOMMENDATION NUMBER 2

AIR QUALITY IN LIVESTOCK BUILDINGS

Manure odours and gases, dust and dirt, and noise all contribute to poor air quality in livestock barns for both the animals and the farm workers. Poor air quality has been verified by the excessively high levels of chronic respiratory problems observed in farm workers. Air quality is one of the main causes of high labour turn over on livestock farms. Hazardous gases, including silo gas, hydrogen sulphide gas and carbon dioxide have on occasion accumulated to toxic levels and caused fatalities to humans and/or farm animals. It is also expected that there are numerous cases of injuries to the lungs of both humans and animals from sub-lethal levels of these noxious gases.

Research is Needed:

1. To study means of reducing the level of air contaminants found in barn environments.
2. To develop improved manure storage systems and management, handling, processing and disposal to reduce hazardous gas generation and minimize odour problems.
3. To determine the chronic effects of sub-lethal gas levels on both humans and livestock and to evaluate the long-term effects of exposure to these hazardous gases.
4. To determine the short and long term effects of barn noise on both humans and livestock.

Applied Research is Needed:

5. To agree on practical and achievable Threshold Limit Values (TLV) for the various air pollutants and combinations of same encountered inside farm buildings.
6. To measure the effect of various additives to the barn environment, feed or manure gutters on subsequent air quality and odour control.
7. To study under-floor ventilation with regard to improved odour control in the animal environment.

8. To develop a thorough evaluation and testing program for warning devices which alert farm personnel that one of the hazardous gases is at a dangerous level.
9. To develop appropriate and practical information for dealing with hazardous gases found at dangerous levels in the animal environment or feed storage area.

RECOMMENDATION NUMBER 3

CORROSION AND DETERIORATION OF AGRICULTURAL BUILDING COMPONENTS

Corrosion problems are evident in some farm structures that could affect their structural integrity. Reinforcing steel in cast-in-place silos and beef and swine floor slats have shown deterioration which could lead to structural failure. In under-floor manure storage structures, manure gas and other air contaminants are accelerating the corrosion and deterioration of all metal components and building equipment. Composting structures are showing corrosion on unprotected metal components after a relatively short time. Also, it appears that some wood preservatives hasten corrosion of the structural fasteners used to connect building members.

Research is Needed:

1. To study the relationship between various odours and gases and moisture levels found in typical livestock environments (also composting structures) and the amount of corrosion occurring on the metal building components.
2. To determine the relationship between various wood preservatives and the amount of corrosion occurring on the metal fasteners connecting these members in a farm building.
3. a) To determine the feasibility of using a steel coating and/or concrete additives to inhibit the corrosion of reinforcing steel in such adverse situations as slatted floors, silos and manure storage.
   b) To determine the feasibility of using concrete sealants and coatings that may reduce concrete deterioration which in turn will protect the reinforcing steel.

RECOMMENDATION NUMBER 4

ICE PRESSURES FOR MANURE TANK DESIGN

Based on the findings of field surveys in the winters of '94-'95 and '95-'96, OMAFRA standard designs for cylindrical tanks were redesigned for 0.2 m, 0.4 m and 0.6 m design ice thickness. After further consideration of the various climatological regions of Ontario recommendations will be made for use of one of these three designs.

Service is needed:

1. To publish the results of the ice build-up survey of manure tanks in Southern Ontario.
2. To publish design information that will assist concrete tank designers in Ontario.

RECOMMENDATION NUMBER 5

TECHNICAL INFORMATION TO ASSIST THE FARM BUILDING INDUSTRY

The Ontario Ministry of Agriculture, Food and Rural Affairs has agreed to assume the co-ordination role for the C.P.S. (Canada Plan Service). This will require an on-going effort to maintain the existing CPS data resources and support the development of new plans and technical leaflets. The farm construction industry requires technical information on several topics; chimney design for natural ventilation, diaphragm bracing for post frame construction, the use of laminated posts, and information regarding tunnel ventilation for combatting animal heat stress. The industry has identified building construction/inspection as an area that needs improvement. In particular, building inspection across the province is not uniform and courses should be mandatory for building officials to assure their education level.

Service is required:

1. To support OMAFRA's effort to maintain the existing CPS data resources and promote the development of new plans and technical leaflets.
2. To develop a design leaflet for chimney design for naturally ventilated livestock buildings.
3. To write a Factsheet regarding tunnel ventilation for livestock and poultry.
4. To write a Factsheet regarding wind forces on farm buildings.
5. To ensure that training/upgrading courses are available for building officials and building contractors so that uniformity of building construction/inspection takes place.

RECOMMENDATION NUMBER 6

STRUCTURAL ISSUES AS A RESULT OF THE 1998 EASTERN ONTARIO ICE-STORM

The January 1998 Ice Storm caused numerous farm building failures in Eastern Ontario. The ice build up on the roofs and additional snow caused loading that approached or exceeded the design loading for the area. The fact that one building failed while another survived with similar or greater loading was evident on many farms. Many factors could be involved that would explain this phenomena. The age of the building could indicate the extent of structural deterioration or might reflect changes in building codes. The manufacturer or type of truss construction could be a factor. Additions to structures and modifications may have led to some failures. Investigation of the failures which occurred during this period may give some indication of what factors were involved. A second stage of investigation could identify buildings that were structurally damaged, did not fail. These may need remedial work before being heavily loaded again. The identification of deterioration in existing buildings and recommendations for remedial actions would be a definite benefit of this investigation. The information gathered in these investigations would then be made available to the agricultural communities through seminars and workshops held at various locations.

Service is needed:

1. To assess the safety of structures in the affected area.
2. Investigate the deterioration of connectors, joints, etc. as influenced by the ice storm loading
3. Evaluation of ice/snow effects on tarp covered arch frame structures (Biotech type)

4. Measure effects of loading on plates, beams, etc. (deflections, etc.)
5. Establish wind effect on snow or ice accumulation
6. Review/revise current Canada Plan Service designs, prepare leaflets and bulletins as needed.
7. Carry out an evaluation of snow/ice removal methods from farm building roofs (steam, de-icers, mechanical).
8. Publish information, organize information meetings, communicate findings to building officials, contractors, building material suppliers and consulting engineers that serve the Eastern Ontario region.

6.2 FOOD ENGINEERING

RECOMMENDATION NUMBER 1

ADVANCED AND NOVEL FOOD PROCESSES FOR BETTER PRODUCTIVITY, QUALITY AND SAFETY OF FOOD

One of the process identified is the non-thermal pasteurization of liquid foods using pulsed electrical field. The work is being conducted for the last few years at the School of Engineering, University of Guelph. Several hurdles have been removed. However more work is needed to make this process commercially viable. Three processes identified are deep-fat frying, pan-frying and baking. Some work on deep-fat frying is in progress at the School of Engineering. Work is needed in the areas of pan-frying of meat patties for *E.coli* safety, and on baking for better product quality.

RECOMMENDATION NUMBER 2

SENSORS, IMAGE PROCESSING AND AUTOMATION FOR HIGHER PRODUCTIVITY, SAFETY AND QUALITY

In-line sensors for the detection of contaminants and quality parameters in foods are needed for consumer safety and product quality. Three processes were identified for image processing: inexpensive in-line methods for detection of glass pieces in glass containers, small chicken bones in mechanically deboned chicken and sclerotia (black fungus) in beans. No work is in progress on these areas. Three in-line sensors were identified: for microbial detection, moisture at high temperature for baked foods and dough properties. Some work is in progress on microbial sensor in the University of Guelph, but no work is being carried out on other sensors.

RECOMMENDATION NUMBER 3

NEUTRACEUTICAL PROCESSING – SEPARATION, PURIFICATION AND CONCENTRATION

Work is needed on the development of efficient methods for separation, purification and concentration of neutraceuticals from various sources (soybean, tomato, hemp, etc.) to be used in supplements and in fortified foods. Some work is in progress in the University of Guelph, and AAFC

laboratory in Guelph. However more work is needed.

RECOMMENDATION NUMBER 4

CHARACTERIZATION OF RAW INGREDIENTS FOR QUALITY CONTROL IN PROCESSED FOODS

No work is in progress in Ontario on this or related topic.

RECOMMENDATION NUMBER 5

THE WINE INDUSTRY GROWTH IN ONTARIO REQUIRES OPTIMUM MATERIAL HANDLING

Applied research is needed in this area for expanding Ontario wine industry. No work is in progress at present.

6.3 RURAL ENVIRONMENT ENGINEERING

RECOMMENDATION NUMBER 1

INVESTIGATE METHODS TO TREAT LIVESTOCK MANURE TO REDUCE ODOURS.

This project involves an examination of various manure treatment options with the specific goal of reducing odour levels. It is especially aimed at liquid swine manure systems, though the suitability for other livestock types should also be considered. Treatment could occur during collection, during transfer to storage, during storage, or some combination. Odour levels should be compared: in the barn, near the storage, during agitation prior to spreading, and during and after spreading on the land (if that is the method of manure use).

RECOMMENDATION NUMBER 2

TO RESEARCH, EVALUATE, AND DEVELOP ALTERNATIVE METHODS OF HANDLING AND DISPOSAL OF LARGE VOLUMES OF SWINE AND DAIRY LIQUID MANURE.

Research should be oriented towards promising technologies (solid-liquid separation, constructed wetlands, composting, adsorption). Finally, systems that address the issue of the treatment of brown water (seepage from the manure pile) are required on dairy farms handling solid manure.

Methods need to be developed to reduce the cost and/or land base required to deal with the large volumes of manure produced and stored by the oncoming large intensive livestock productions in a cost effective and environmentally sustainable manner.

RECOMMENDATION NUMBER 3

TO EVALUATE AND QUANTIFY THE IMPACT OF LARGE LIVESTOCK OPERATIONS ON THE RURAL ENVIRONMENT.

A comprehensive study is required to evaluate and quantify the impact on the environment by large livestock operations. Items that must be studied are:

1. Odours from the buildings
2. Odours from the manure storage
3. Odours from spreading large volumes of manure
4. Impact of manure transport on public roads
5. Ability to handle large quantities of manure and the time required
6. Suitability of methods of spreading manure (odour and water impacts)
7. Effects of concentration of livestock facilities in an area versus spot development
8. Do MDS formulas adequately assess large livestock units
9. Potential impact on ground water supplies

RECOMMENDATION NUMBER 4

TO IDENTIFY SOURCES OF WATER CONTAMINATION IN AGRICULTURAL WATERSHEDS AND PUT INTO PERSPECTIVE THE VARIOUS CONTRIBUTORS.

A comprehensive study is needed to examine all sources of water contamination in agricultural watersheds and put into perspective the relative contributions of the various sources. This should focus on surface water quality. Key indicators would include: suspended sediment, nitrate-N, BOD, E. Coli bacteria, total P, and others. Practices to consider would include:

1. Farm practices such as: tillage, nutrient management, manure storage and spreading, livestock pasturing, crop rotation; and
2. Non-farm practices such as road construction and maintenance, rural septic system use, municipal sewage treatment plant scheduled and unscheduled releases, other spills, wildlife, etc.

RECOMMENDATION NUMBER 5

RURAL HOUSEHOLD ALTERNATIVE WASTE TREATMENT SYSTEMS FACTSHEET.

To develop a factsheet outlining the various alternative household waste treatment systems that are available now or could be in the near future.

RECOMMENDATION NUMBER 6

SYMPOSIUM ON LARGE LIVESTOCK OPERATIONS AND THE RURAL ENVIRONMENT

To convene a symposium to address the topic of large livestock operations and the rural environment.

RECOMMENDATION NUMBER 7

TO ASSESS AND ESTABLISH AGRICULTURE'S BASELINE NEEDS FOR DRAINAGE, WATER SUPPLY, NUTRIENT USE IN ORDER TO FIND AN EQUITABLE BALANCE WITH OTHER USES OF THE RURAL ENVIRONMENT SUCH AS FISHERIES, WILDLIFE, AND NATURAL HABITAT.

Research is required to determine the base line needs of agriculture in Ontario to be competitive in world markets and then to determine how far it can go in addressing the issue of environmental sustainability. The research should deal with these specific topics:

RECOMMENDATION NUMBER 8

TO DEVELOP A NUTRIENT MANAGEMENT EXTENSION PROGRAM FOR ONTARIO FARMERS.

A nutrient management extension program should be developed and delivered to farmers throughout Ontario. The program should stress the importance of nutrient management on farms from the perspective of yield, timing of nutrient applications, crediting use of manure and other organic materials and minimizing risk of damage to the environment.

Farmers should be encouraged to soil test and analyse manure as a basis for developing a good nutrient management program. Aids such as a computer program and nutrient management worksheets are available to assist the farmer in doing this plan.

RECOMMENDATION NUMBER 9

TILE WATER SAMPLING PROTOCOLS AND ANALYSIS

To develop a tile water sampling protocol and analysis interpretation information package.

RECOMMENDATION NUMBER 10

CENTRE TO STORE, CATALOGUE, MARKET AND DISSEMINATE RESEARCH DATA

To develop a system whereby data collected from research projects funded for or related to agriculture can be stored in a standardized useable format, catalogued for easy retrieval, evaluated for quality and to establish a central storage facility for this information to be stored, marketed and disseminated.

RECOMMENDATION NUMBER 11

TO EVALUATE THE APPLICATION OF NATURAL CHANNEL DESIGN SYSTEMS TO MUNICIPAL DRAINS IN AGRICULTURAL ONTARIO AND TO INVESTIGATE INEXPENSIVE METHODS OF ADAPTING NATURAL CHANNEL DESIGN TECHNIQUES TO EXISTING MUNICIPAL DRAINS.

The research should deal with these specific topics:

1.1 A literature review on natural channel design techniques with a critique on it's application to municipal drains in Ontario.

1.2 Investigate adaptations of natural channel design techniques that could be applied to existing municipal drains to optimize the benefits while minimizing costs.

1.3 Apply the design adaptations determined in 2) to an existing municipal drain site. Measure the success of the adaptation by monitoring drainage capacity, water quality, diversity of biota, etc.

RECOMMENDATION NUMBER 12

FARM FUEL STORAGE INFORMATION PACKAGE AND EXTENSION PROGRAM

To develop a farm fuel storage information package and establish an extension program for farmers and fuel suppliers on proper fuel storage and fuel handling techniques as required by the recently updated (1993) Gasoline Handling Act and the Gasoline Handling Code.

RECOMMENDATION NUMBER 13

TO ASSESS NON-CONVENTIONAL FORMS OF WATER MANAGEMENT WITH THE FOCUS ON GROUND AND SURFACE WATER TREATMENT SYSTEMS.

Research is required to investigate, develop, and evaluate ground and surface water treatment systems that could be used to reduce the amount of contaminants reaching water sources. Techniques which promote the immobilization, destruction, or transformation of contaminants such as organic fertilizers, barnyard runoff, chemical fertilizers, milkhouse washwater etc. must be tested at the fields and the watershed. These techniques should include artificial marshes or wetlands, water quality basins, infiltration ponds, and various vegetative infiltration systems.

RECOMMENDATION NUMBER 14

EFFECTIVENESS OF ENGINEERING RELATED MANAGEMENT PRACTICES FOR THE PROTECTION OF WATER QUALITY

Additional research is needed to verify the effectiveness of existing and proposed structures and management practices intended to control the quality of water leaving areas of agricultural production. The research should focus on establishing the pathways that carry potential contaminants away from sites where the contaminants are being controlled or treated, fluxes along these pathways, and the processes that control the concentrations and amounts of substances that reach receiving waters. The research should focus on the identification of important processes through field studies, the quantification of process parameters through a combination of field and laboratory studies, and the development and refinement of computer models for simulating the processes. Special attention should be given to examination of hydrologic processes that apply in periods during and immediately after snowmelt.

The required research should deal with these topics:

1.1 The role of preferential flow through macro-pores in conveying chemicals and bacteria to buried-pipe drains.

1.2 The partitioning of nitrate between drainage from buried pipes and percolation to deeper groundwater under tile-drained fields.

RECOMMENDATION NUMBER 15

MANURE APPLICATION FOR CONSERVATION TILLAGE SYSTEMS

Further research and on-farm evaluation is required to study the effects of manure application in combination with soil conservation tillage methods. With conservation tillage practices, a different soil structure results having a different moisture retention capacity. It is important to know the sensitivity of the groundwater movement as affected by the conservation tillage techniques to have some indication of pollution potential. Alternative methods of manure application on conserving soil systems should be investigated.

RECOMMENDATION NUMBER 16

ASSESSMENT OF WATER QUALITY IMPROVEMENT DUE TO OUTLET CONTROLLED WATERTABLE MANAGEMENT

Research is needed into additional methods of watertable management that are alternatives or additions to the normal drainage function of subsurface buried-pipe drains. The alternatives or additions include the construction of control structures to maintain submerged conditions at drain outlets for subirrigation during dry periods or controlled drainage for water quality improvement (e.g., denitrification) and flowrate regulation.

Research is needed to examine these alternatives separately and in combination to see how successful they are in meeting the anticipated design objectives, what combinations of alternatives are compatible, what difficulties any of these alternatives create for the achievement of traditional goals of soil drainage, and how the alternatives compare in economy and durability with existing standard methods (if any exist).

The kind of research required includes field measurements of the performance of trial installations. The data collected should include soil water amounts as they vary with time, quantity and quality of outflow water and the change in quality during passage through the system, variation of watertable position with time, and the yield of crop from the field receiving treatment.

RECOMMENDATION NUMBER 17

RESEARCH TO DETERMINE THE APPROPRIATE TILE DRAIN SPACING FOR FIELDS UNDER NO-TILL CULTIVATION.

There is a significant change in the methods of tillage by farmers today. There are programs which encourage farmers to change to conservation tillage which in effect reduces the rate and volume of

water which leaves the field as surface water. These procedures put an increased demand on sub-surface drainage which should be studied to determine whether present design guidelines are still appropriate.

RECOMMENDATION NUMBER 18

DEVELOP GUIDELINES FOR THE BIOREMEDIATION AND/OR DISPOSAL OF SOIL AND WATER CONTAMINATED BY DIESEL AND HEATING FUEL ON FARMS.

1. Methods of bioremediation must be identified and assessed for farm scale situations.
2. Methods of optimizing environmental conditions for bioremediation must be identified and tested on farm sites.
3. Observation criteria for judging the success of the remedial process must be established.
4. Recommendations should be compiled into factsheet.

RECOMMENDATION NUMBER 19

VEGETATIVE COVERS FOR STREAM BANK EROSION CONTROL

The choice of vegetative covers for erosion control is dependent on regional climatic, soil and topographical conditions. Regionalised research work is required.

RECOMMENDATION NUMBER 20

DRAINAGE OF FINE TEXTURED SOILS - PUBLICATION

Various drainage projects are conducted in order to solve the problem of draining fine textured soils. They include moling, crowning and the use of small diameter tiles. Proven results must be made available to farmers working on such soils as well as farm contractors. Guidelines as a supplement to the drainage guide of Ontario are presently being prepared.

RECOMMENDATION NUMBER 21

TO INVESTIGATE AND ENCOURAGE DEVELOPMENT OF GPS SYSTEMS TO DRAINAGE INSTALLATION INDUSTRY.

Locating tiles post construction adds unnecessary costs to systems that are upgraded. GPS systems could potentially address this problem if applied to new installations and records kept. The same technology could be applied for accurate location of tiles in the future. More beneficial would be the application of this technology to the control of the drainage machinery during installation.

7.0 RECOMMENDATIONS ARISING FROM THE GAPS/BARRIERS/ DEFICIENCIES

7.1 LIVESTOCK ENGINEERING

RECOMMENDATION NUMBER: 1

ISSUE: Animal & Human Health

SOURCE: Livestock Engineering Subcommittee

OASCC LINKAGE: Animal Committee

TARGET AGENCY: Agricultural Research Institute Of Ontario
Canadian Agricultural Research Council

LIVESTOCK BUILDING DESIGN, CONSTRUCTION and HUSBANDRY SYSTEMS RELATIONSHIP TO ANTIMICROBIAL RESISTANCE, HUMAN and ANIMAL HEALTH

Details:
The use of antibiotics in animal production has been linked to the development of antimicrobial resistant bacteria that cause disease and death in humans. Corrections to housing and husbandry are critical first steps to avoid sickness, death, compromised animal welfare, and lost productivity before antibiotics become less available. The antimicrobial resistance - human health issue will drive the banning of antibiotic growth promoting products sooner than most might expect. Livestock producers need to know what renovations to make to existing animal husbandry units and what features to build into new units to prepare for the inevitable ban.

Research is needed:
1. To identify the design, construction and husbandry systems in livestock buildings that compliment high livestock health and performance without the use of antibiotic growth promotants or the subtherapeutic use of antibiotics. (Conversely, to identify the design, construction and husbandry systems that contribute to disease and impaired performance that require the use of subtherapeutic antibiotics.)
2. To develop practical and economical designs and construction methods for renovating existing buildings or building new structures to enable high livestock health and performance.
3. To develop practical and economical modifications to existing husbandry systems or create new husbandry systems within livestock buildings to enable high livestock health and performance.
4. To identify and/or develop practical and economical design, construction and husbandry systems that minimize disease transmission. (Conversely, to identify design, construction and husbandry systems that contribute to the spread of infectious diseases.)

Funding is needed:

1. To create a centre for livestock husbandry planning to enable dialogue between scientists in the disciplines of engineering, waste management, nutrition, veterinary medicine, economics, and human medicine (to name a few) directed at livestock housing systems, animal and human health, and the reduction of the use of antimicrobial products.
2. To enable the creation and implementation of a national strategy focussed on livestock buildings and husbandry systems to reduce the use of subtherapeutic antibiotics.
3. To enable the development of national standards in housing, construction and husbandry systems focussed directly at ensuring high livestock health and performance without the use of subtherapeutic use of antibiotics.
4. To enable validation of the above mentioned national standards on Canadian farms.

Background:

Historically, owners, veterinarians or feed company personnel reach for antibiotics for treatment, prevention or growth promotion. Too many livestock housing and husbandry systems have compromises leading to contamination of feed and water with manure, exposure of young stock to manure from adults, excessive humidity, and poor air quality, as a few examples. These compromises lead to unnecessary animal stress, bacterial load in the animal environment, exposure and challenges to infectious agents, and disease requiring treatment or prevention with antibiotic therapy. Efforts to optimize the design, construction and husbandry systems at the outset would and could negate the need for antibiotic therapy in the future. To minimize the use of subtherapeutic antibiotics in livestock production, livestock producers need to build appropriate housing and husbandry systems.

Unfortunately, Canada does not have any codes regulating building and husbandry system characteristics that compromise animal health, necessitate the need for subtherapeutic antibiotic therapy, or ultimately pose a risk to human health through development of antimicrobial resistant bacteria following this use of antibiotics.

Some research is needed to quantify the influence of livestock housing in Canada on livestock health and performance. The Canadian and international literature needs to be reviewed and knowledge gaps identified. In addition, we need to quantify what facilities and systems contribute to high health and those that do not. We need this information for risk assessment purposes prior to implementing an antibiotic ban.

Cost/benefit:

Reports from Sweden show increased sickness, death and lost production following the ban of antibiotic growth promotants or the use of antibiotics at subtherapeutic levels. However, after altering livestock building characteristics and husbandry systems, health and performance returned to levels equal to or greater than those achieved with antibiotic use. One might conclude then that antibiotic use is a Band-Aid for deficiencies in housing and husbandry systems, and an unwarranted on-going cost of production. Denmark attended to the housing systems prior to the antibiotic ban and did not experience the health and performance problems seen in Sweden. In both countries, surveillance shows a decrease in frequency of antimicrobial resistant bacteria. Both countries

believe there is a definite benefit to human health and health care systems from banning the subtherapeutic use of antibiotics.

RECOMMENDATION NUMBER: 2

ISSUE:	Air Quality in Livestock Buildings
SOURCE:	Livestock Engineering Subcommittee
OASCC LINKAGES:	Animal Committee, Soil Water and Air Committee
TARGET AGENCY:	Agricultural Research Institute Of Ontario Canadian Agricultural Research Council Agriculture & Agri-Food Canada

AIR QUALITY IN LIVESTOCK BUILDINGS

Details:

Manure odours and gases, dust and dirt, and noise all contribute to poor air quality in livestock barns for both the animals and the farm workers. Poor air quality has been verified by the excessively high levels of chronic respiratory problems observed in farm workers. Air quality is one of the main causes of high labour turn over on livestock farms. Hazardous gases, including silo gas, hydrogen sulphide gas and carbon dioxide have on occasion accumulated to toxic levels and caused fatalities to humans and/or farm animals. It is also expected that there are numerous cases of injuries to the lungs of both humans and animals from sub-lethal levels of these noxious gases.

Research is Needed:

1. To study means of reducing the level of air contaminants found in barn environments.
2. To develop improved manure storage systems and management, handling, processing and disposal to reduce hazardous gas generation and minimize odour problems.
3. To determine the chronic effects of sub-lethal gas levels on both humans and livestock and evaluate the long term effects of exposure to these hazardous gases.
4. To determine the short and long term effects of barn noise on both humans and livestock.

Applied Research is Needed:

5. To agree on practical and achievable Threshold Limit Values (TLV) for the various air pollutants and combinations of same encountered inside farm buildings.
6. To measure the effect of various additives to the barn environment, feed or manure gutters on subsequent air quality and odour control.
7. To study under-floor ventilation with regard to improved odour control in the animal environment.
8. To develop a thorough evaluation and testing program for warning devices which alert farm personnel that one of the hazardous gases is at a dangerous level.
9. To develop appropriate and practical information for dealing with hazardous gases found at dangerous levels in the animal environment or feed storage area.

Background:
Work is still required to develop appropriate strategies for dealing with the various air pollutants, odours and noise levels found in livestock barns. Today's farm workers spend most of their time inside livestock buildings, feed and grain storages as well as operating noisy machinery. They are exposed to high concentrations of different organic dusts such as grain dust, animal epithelial, hair, proteins from urine and faeces, mites, bacteria, endotoxins and mold spores. Also, these particles are associated with various toxic gases such as ammonia, hydrogen sulphide, carbon monoxide, etc.

Several of these toxic gases are either odourless or have the ability to paralyse the nervous system and thus are hard to detect when present at harmful concentrations. As farming operations become larger, more hired labour is employed and this increases the chance of short-cuts or misunderstood safety procedures. With several gases involved, more than one warning device may be needed to cover all of the needs of a particular environment. Any such warning device must be reliable over time when located in such a harsh building environment. This type of gas sampling equipment already exists but needs to be evaluated and/or adapted to suit the specific needs of animal environments. Cost will be an important factor in convincing farmers to install these devices. Many producers inquire about chemical additives to the feed, water or manure storage which might reduce odours and toxic gases. Some work is being done by Agriculture Canada, Ridgetown Agricultural College, University of Saskatchewan and Iowa State University, however much is still unknown about the effectiveness of these additives. There may be opportunities for gas and odour reduction within the animal environment with alternative manure handling, processing and disposal systems. There is no known work in this area.

Cost/Benefit: From research work done in Europe and the USA, it has been estimated that 25% to 40% of all the livestock producers and their family members, as well as their farm workers suffer to varying degrees from bronchitis, occupational asthma, organic dust toxic syndrome or general irritation of mucosal membranes due to the poor air quality inside livestock buildings. Applying this estimate to Ontario, there would be between 30,000 and 50,000 people suffering from poor indoor air quality on dairy, beef, swine and poultry farms. It is extremely difficult to evaluate the cost to society because of a reduction of productivity by workers' absenteeism and medical care services directly related to barn air quality. Additionally, it is impossible to assess the cost or loss of revenue encountered by producers because of the difficulty in recruiting, training and maintaining reliable farm workers.

The presence of toxic gases is a human and animal safety issue that is difficult to quantify in dollars. If some animals are killed due to exposure to H_2S gas, not only is there the direct animal losses, but also the down time while another group of animals is raised on farm or purchased to replace those lost. Manure gas, silo gas and carbon dioxide (sealed silo) have all claimed human lives on farms. What is the value of a human life? If a simple gas detector could be marketed for a reasonable cost, along with a proven procedure for reducing hazardous gas levels, it would significantly reduce the number of animal and human respiratory injuries and possible fatalities.

Resources:

The University of Guelph, Prairie Swine Research Centre, University of Alberta and University of Saskatchewan have all done some work with air pollutants in livestock buildings but much more work is required. An interdisciplinary task force of agricultural engineers, researchers, veterinarians, physicians and occupational health specialists should be assembled to address threshold limit values for indoor air contaminants, odours and noise levels in farm buildings.

Both Agriculture Canada and OMAFRA have done some research and extension in the areas of manure and silo gas. As well, the University of Guelph, OMAFRA, Prairie Swine Research Centre and the University of Saskatchewan have all done some studies on air contaminants and dust in livestock environments. More needs to be done with commercial scientific instrument companies that already market gas detection equipment. Similarly, it may be possible to co-operate with chemical or feed companies regarding the potential for additives.

RECOMMENDATION NUMBER: 3

ISSUE:	Corrosion of Metal Building Components
SOURCE:	Livestock Engineering Subcommittee
OASCC LINKAGES:	Animal Committee, Horticultural Crop Committee
TARGET AGENCY:	Agricultural Research Institute Of Ontario, Canadian Agricultural Research Council Agriculture & Agri-Food Canada

CORROSION AND DETERIORATION OF AGRICULTURAL BUILDING COMPONENTS

Details:

Corrosion problems are evident in some farm structures that could affect their structural integrity. Reinforcing steel in cast-in-place silos and beef and swine floor slats have shown deterioration which could lead to structural failure. In under-floor manure storage structures, manure gas and other air contaminants are accelerating the corrosion and deterioration of all metal components and building equipment. Composting structures are showing corrosion on unprotected metal components after a relatively short time. Also, it appears that some wood preservatives hasten corrosion of the structural fasteners used to connect building members.

Research is Needed:

1. To study the relationship between various odours and gases and moisture levels found in typical livestock environments (also composting structures) and the amount of corrosion occurring on the metal building components.
2. To determine the relationship between various wood preservatives and the amount of corrosion occurring on the metal fasteners connecting these members in a farm building.
3. a) To determine the feasibility of using a steel coating and/or concrete additives to inhibit the corrosion of reinforcing steel in such adverse situations as slatted floors, silos and manure storage.
   b) To determine the feasibility of using concrete sealants and coatings that may reduce concrete deterioration which in turn will protect the reinforcing steel.

Background:

Silage juices and liquid manure are able to attack the concrete and over time penetrate to the reinforcing steel which in turn corrodes very quickly. The agricultural industry needs a more durable concrete product. Should coated reinforcing bars, concrete additives, coatings and sealants be used, alone or in combination? Concrete slat deterioration has become a significant problem.

The combination of various gases along with higher humidity levels found in livestock barns tend to corrode all metal components of the building and equipment. Proper ventilation plays a role, but

to what extent? A field study by OMAFRA revealed that almost half of the livestock buildings investigated had moderate to severe corrosion occurring on the metal gusset plates.

Wood preservatives have been used with good success to protect the building members from deterioration. Concern has now been raised that some preservatives seem to cause an accelerated corrosion of the metal fasteners connecting these treated members in a typical farm building. The farm building industry needs to know which preservatives should be recommended or whether the fasteners need to be coated to prevent this corrosion process.

Cost/Benefit:
In 1994, the cost of depreciation on all Ontario agricultural structures was $234.2 million. As well, $130.24 million was spent on building repairs. Since agricultural structures may need to be repaired or replaced prematurely because of this deterioration, these costs could be substantial. On average, corrosion could account for a 10% loss of expected building life. It is estimated that the value of Ontario farm buildings is $10 billion and the average life expectancy of a farm building is 25 years. As a result of corrosion, if the building lasts for only 22.5 years, this results in an annual cost of $44 million.

Livestock housing costs account for 10-20% of the total cost of production. Any shortening of the service life will increase these costs. In addition, if there is a structural failure, there may be additional financial hardship and potential for both human and animal injury or fatality. It is unlikely that any research recommendations concerning suitable coatings, sealants or concrete additives would increase overall building construction costs by more than 5%. If the value of agricultural structures in Ontario is $10 billion, and their life is 22.5 years, approximately $444 million is spent on new construction annually. If the cost to resist corrosion in these structures is 5 percent, this would amount to an annual cost of $22 million.

Therefore the cost/benefit ratio is 22/44 = 1:2

Resources:
O.M.A.F.R.A. has evaluated several coatings for use on concrete silo walls. All Ontario concrete slat manufacturing plants are now certified by CSA which should ensure a quality slat for all new buildings. Concrete slat manufacturers are promoting several different approaches to providing increased durability. It is important for cooperative research to take place with these manufacturers. Additionally, the steel industry has good data available on coated reinforcing steel and may wish to collaborate on this type of work. Similarly, the steel industry should expect to work with researchers and the chemical industry to establish recommendations concerning the use of various coatings on metal components in corrosive environments.

RECOMMENDATION NUMBER: 4

ISSUE: Ice Pressure and Structural Design

SOURCE: Livestock Engineering Subcommittee

TARGET AGENCY: The Ontario Ministry of Agriculture, Food and Rural Affairs

ICE PRESSURES FOR MANURE TANK DESIGN

Details:
Based on the findings of field surveys in the winters of '94-'95 and '95-'96, OMAFRA standard designs for cylindrical tanks were redesigned for 0.2 m, 0.4 m and 0.6 m design ice thickness. After further consideration of the various climatological regions of Ontario recommendations will be made for use of one of these three designs.

Service is needed:
1. To publish the results of the ice build-up survey of manure tanks in Southern Ontario.
2. To publish design information that will assist concrete tank designers in Ontario.

Background:
The 1995 National Farm Building Code (NFBC) specifies that "manure storage tank walls shall be designed to withstand anticipated horizontal ice pressures". In an appendix, the Code states that these pressures may reach values of 50 kPa acting over a height of 0.5 m at the level of the liquid. This value originated in the Quebec City area (Laval University). No values are available for Ontario's less severe climate, especially in the south where most liquid manure tanks are built.
Shelley Bonte-Gelok, a fourth year engineering student at Guelph, carried out a second field study during December, 1995 to March, 1996 to measure the extent of ice build-up in manure tanks. The dozen tanks examined were about the same as those in the field study of the previous winter. Although the 95-96 winter was closer to "normal" than 94-95 there was no evidence found of ice damage to tanks. Ice thicknesses in Southern Ontario were found to be 0.2 – 0.3 m rather than the 0.5 m mentioned in the NFBC.

Cost/Benefit:
The additional design loading recommended by Laval University had the potential to cost farmers additional dollars in the construction of their manure storage tanks. As yet, the increased cost is unknown. The results of this project will allow farmers to continue building cylindrical liquid manure tanks in most agricultural areas without any substantial increase in cost. Only in the very coldest regions of Ontario will the standard designs have to be strengthened to allow for the substantial ice pressures that will occur in those regions. A 100 ft. (diameter) x 12 ft. (depth) concrete manure storage tank costs approximately $40,000. A failure of this tank will result in a loss of that value plus associated cleanup costs and possible environmental damage. Clean-up costs are variable but typically could approach $20,000 in this type of failure. In extreme cases, the additional

reinforcing required could result in a 15% increase in initial cost. Therefore, the cost/benefit ratio is $6000/$60000 = 1:10

Resources:
Dr. Jofriet, University of Guelph and J. Johnson, OMAFRA will work together to produce the appropriate documents. Dr. Jofriet has produced additional information in 1998 that brings the project closer to completion.

7.2 FOOD ENGINEERING

RECOMMENDATION NUMBER: 1

ISSUE:	Advanced and novel food processes for better productivity, quality and safety of food
SOURCE:	Food Engineering Subcommittee
OASCC LINKAGE:	Food processing committee.
TARGET AGENCIES:	Recommendation to ARIO and OMAFRA.

IMPROVED TECHNOLOGIES FOR PASTEURIZATION SUCH AS NON-THERMAL PROCESSES TO REDUCE PROCESSING COST AND TO ENHANCE NUTRITIONAL AND FLAVOUR QUALITY, AND SHELF LIFE.

Details:

The new and improved non-thermal pasteurization processes should increase product quality and process efficiency. Novel technologies are needed to safely extend shelf life without perceptibly altering the natural flavour, composition and taste of foods. The new technologies should maintain product quality standards and integrity, minimize energy utilization, and maximize yields.

The beverage industry has an immediate need for replacing thermal pasteurization as consumers are interested in minimal processed and fresh-like fruit juices. The conventional process is not only energy intensive but denature the products' colour, flavour and vitamin content. There is great need for a non-thermal pasteurization that is safe, energy efficient, economical and does not affect nutrition and flavour. Wine manufacturers are also interested in non-thermal pasteurized grape juice for better flavour of wines.

Background:

The food manufacturing industry is facing increasing global competition, government regulations and consumer demands. These challenges require adoption of new technologies and methodologies to create and sustain a competitive advantage in the market place.

Even a small improvements in manufacturing technology through technological innovation, efficiency improvements or resource utilization would have a large economical effect on food industry given its size. A 1% improvement in productivity by improved and novel technologies will save $50 million per year.

The recommendation should be addressed by research institutions and universities, food industry, and collaborative research between industry and academic researchers. There is some current research activities at the School of Engineering, University of Guelph in this area.

RECOMMENDATION NUMBER: 2

ISSUE:	Advanced and novel food processes for better productivity, quality and safety of food
SOURCE:	Food Engineering Subcommittee
OASCC LINKAGE:	Food processing committee.
TARGET AGENCIES:	Recommendation to ARIO, AAFC and OMAFRA.

BAKING AND FRYING PROCESSES MODELLING TO IMPROVE BAKED AND FRIED PRODUCTS' QUALITY.

Details:

Modern cooking systems are becoming complex due to industry's expanding need for higher production, short cooking time, consistency and better quality, higher yield, energy efficiency and versatility. The models will provide a better understanding of the process mechanisms, assist with better design of equipment and process, and will promote the more efficient use of existing equipment. A detailed understanding of the fat transfer profile is of major interest to processors as consumers are more aware about the amount of fat they consume. Optimization of the process parameters will result in better process control, product quality, and lower fat. Pan-frying process required to be studied with respect to the changing physical properties and chemical composition of beef patties during cooking and consequent microbial destruction. Heat, moisture and fat transfer within the food and crust formation occur during cooking including deep-fat frying, broiling, baking, pan frying. Cooking is still considered more of an art than a science. For cooking to be adequately controlled, designed and optimized, the food quality kinetics during cooking must be understood. Fried foods constitute a large percentage of the snack food industry. Research on frying has generally concentrated on the kinetics of oil degradation. Little is known about the fat transfer during frying as affected by edible coatings of frozen products. Recent consumer trend toward healthier foods is creating significant pressure to reduce fat in cooked products. Fried foods still contain large amount of fat, in some cases >45%. Excess fat consumption is considered as the key dietary contributor to coronary heart disease and cancer of breast, colon and prostate.

Background:

As the market for fully cooked products continues to expand, modelling and simulation that predict product temperature, cooking yield, and pathogen lethality during cooking will be valuable tools for designing effective and safe thermal processes. With the increasing concern on safety and quality of beef and chicken patties, the importance of prediction of heat and fat transfer, microbial lethality and optimization of pan-frying is evident. The development of in-line sensors and process modelling and optimization will be critical in implementing total quality management (TQM) and HACCP in the food industry. The food industry represents about $5 billion of Ontario's GDP. A 1% improvement in productivity through improved process control represents $50 million.

Collaborative research on these needs is required between researchers from research institutions and universities and food industry.

RECOMMENDATION NUMBER: 3

ISSUE:	Sensors, image processing and automation for higher productivity, safety and quality
SOURCE:	Food Engineering Subcommittee
OASCC LINKAGE:	Food processing committee.
TARGET AGENCIES:	Recommendation to ARIO, AAFC and OMAFRA.

IMAGE PROCESSING FOR INEXPENSIVE IN-LINE METHODS FOR DETECTION OF GLASS PIECES IN GLASS CONTAINERS, CHICKEN BONES IN MECHANICALLY DEBONED CHICKEN AND SCLEROTIA (BLACK FUNGUS) IN BEANS.

Details:

Baby foods and fruit juices are generally filled in glass containers due to consumer preference. During filling of foods or juices in glass containers at high speed, occasionally, a few glass containers are shattered due to impact. Consequently, a few pieces of broken glass with variant sizes may find their way into the containers during this shattering process. To detect containers that contain glass pieces, a scanning system is needed. For this system to be of practical value it has to be cost effective and fast enough so as to cope with the speed of the filling process. Currently, there are a few systems in the market. These systems are based on x-ray technology. Unfortunately, the speed and high cost of such systems are among the major factors that hinder their use in these applications. Since popularity of ground chicken products are increasing, the demand for deboned chicken is also increasing. Detection of small chicken bones in deboned meat is difficult. An in-line detection system is needed so that these small pieces of bones can be separated. Similarly sclerotia due to black fungus in white-beans reduces the quality of the product. Image processing based method seems to be suitable for the separation of sclerotia.

Background:

The development of in-line image processing detection devices for above-mentioned problems will be critical for food safety and quality, and in implementing total quality management (TQM) and HACCP in the food industry. The food industry represents about $5 billion of Ontario's GDP. A 1% improvement in productivity through improved process control represents $50 million.

Collaborative research on these needs is required between researchers from research institutions and universities and food industry.

RECOMMENDATION NUMBER: 4

ISSUE:	Neutraceutical processing -- separation, purification and concentration
SOURCE:	Food Engineering Subcommittee
OASCC LINKAGE:	Food processing committee.
TARGET AGENCIES:	Recommendation to ARIO, AAFC and OMAFRA.

DEVELOPMENT OF EFFICIENT METHODS FOR SEPARATION, PURIFICATION AND CONCENTRATION OF NEUTRACEUTICALS FROM VARIOUS SOURCES (SOYBEAN, TOMATO, HEMP, ETC.) TO BE USED IN SUPPLEMENTS AND IN FORTIFIED FOODS.

Details:

The separation, purification and concentration of neutraceuticals and functional foods are critical for their quality and functionality. Neutraceuticals and functional foods will be used in supplements and in fortified foods. Suitable process is needed for isolating isoflavones from soybeans. A significant body of work is required to understand the properties of neutraceuticals and to develop process technologies that ensure the functionality of these ingredients remains intact. This is an area of high interest to many in the food business.

Background:

The neutraceutical market is increasing day by day. If Canadian food industry will not develop the products containing neutraceuticals, then consumers will get the foods fortified with neutraceuticals from USA or other countries.

This recommendation should be addressed by the industry, research institutions and academic researchers.

RECOMMENDATION NUMBER: 5

ISSUE:	Sensors, image processing and automation for higher productivity, safety and quality
SOURCE:	Food Engineering Subcommittee
OASCC LINKAGE:	Food processing committee.
TARGET AGENCIES:	Recommendation to ARIO, AAFC, CCF and OMAFRA.

IN-LINE SENSORS FOR MICROBIAL DETECTION, MOISTURE AT HIGH TEMPERATURE FOR BAKED FOODS AND DOUGH PROPERTIES

Details:

Due to complex nature of food and its processing, in-line sensing of food quality and microorganisms is needed. Inexpensive and reliable sensors and methods are needed for these. Process controls need measurement of key process parameters to determine the current operating conditions. In-line sensors for monitoring many food quality and safety parameters are not available.

Control of optimized processes is presently limited not by lack of computer or control devices, but by lack of sensors to measure specific food properties. Development of suitable sensors is needed for control systems to measure the critical process parameters and assist in their control. The lack of sensors and control systems for food processes is a major impediment to development of a fully automated food processing system.

Artificial neural network (ANN) is a useful tool for real-time prediction of data and for online process control.

Background:

The development of in-line sensors, ANN and process modelling and optimization will be critical in implementing total quality management (TQM) and HACCP in the food industry. The food industry represents about $5 billion of Ontario's GDP. A 1% improvement in productivity through improved process control represents $50 million.

Collaborative research on these needs is required between researchers from research institutions and universities and food industry.

RECOMMENDATION NUMBER: 6

ISSUE:	Characterization of raw ingredients for food quality control in processed foods
SOURCE:	Food Engineering Subcommittee
OASCC LINKAGE:	Food processing committee.
TARGET AGENCIES:	Recommendation to ARIO, AAFC, CCF and OMAFRA.

RAW MATERIAL CHARACTERIZATION FOR PRODUCT QUALITY.

Details:

There is quite a large variability in raw food material (cereals) from year to year and batch to batch. These variabilities are affecting functionality of the ingredients particularly for cereal industry manufacturing breakfast cereals, breads, cookies, etc. This research will minimize undesirable changes due to processing, and will improve productivity. The present lack of sufficient data on physical properties of basic food ingredients and products has limited the application of many well established engineering principles.

Background:

The quantification and modelling of food properties and processes will be critical in improving the productivity in food industry. Based on the improvement in the productivity by this research of 0.5%, the net saving to the food industry will be $25 million per year.

This recommendation should be addressed by the industry, research institutions and academic researchers.

RECOMMENDATION NUMBER: 7

ISSUE: Wine industry growth in Ontario requires optimum material handling

SOURCE: Food Engineering Subcommittee

OASCC LINKAGE: Food processing committee

TARGET AGENCIES: Recommendation to ARIO, AAFC, FCC and OMAFRA.

OPTIMIZING MATERIAL HANDLING IN THE WINE INDUSTRY.

Details:
Due to the rapid growth of wine industry in Ontario in recent years, there is a need to improve its productivity. One of the area suggested is the optimization of material handling so that process efficiency can be improved, byproducts can be minimized and utilized, and processing wastage can be minimized.

Background:
The optimization of material handling will be critical in improving the productivity in wine industry. Applied research is needed in this direction so that the wine industry can use the information without doing in-house research or trial approach.

Some research is also needed to minimize and utilize processing waste from the wine industry.

This recommendation should be addressed by the industry, research institutions and academic researchers. It is difficult to estimate the economical impact on the wine industry.

7.3 RURAL ENVIRONMENT ENGINEERING

RECOMMENDATION NUMBER: 1

ISSUE: Investigate methods to reduce livestock manure odours

SOURCE: Rural Environment Engineering Subcommittee

OASCC LINKAGE:

TARGET AGENCY: Agriculture & Agrifood Canada - Eastern Region
Agricultural Research Institute Of Ontario
Canada Committee on Animals

INVESTIGATE METHODS TO REDUCE LIVESTOCK MANURE ODOURS.

Details:
This project involves an examination of various manure treatment options with the specific goal of reducing odour levels at the barn and storage. It is especially aimed at liquid swine manure systems, though the suitability for other livestock types should also be considered. Treatment could occur during collection, during transfer to storage, during storage, or some combination. The feasibility of biofilters, mechanical systems, aeration, bacterial and enzyme methods etc. need to be investigated. There are two phases of odour generation to investigate i) from the barn and ii) from the storage.

Background:
Livestock manure, like any other biological material, undergoes a breakdown of organic matter by microorganisms. When this happens in anaerobic conditions, such as with traditional liquid manure systems, it results in odours. Proper separation distances to conflicting land uses, good housekeeping practices, and covers on storages are examples of methods farmers have used to reduce odour impacts. These approaches are not enough to satisfy the present day rural population. Manure treatment research has been going on for many years but the focus has not always been odour control - other factors have included: reducing volume, concentrating or changing the form of nutrients, producing methane, etc. Research is needed to examine methods of odour control practical for use on today's farms, especially targeted at large swine farms with liquid manure. Composting of liquid manure is one technology that is being investigated and should continue. Others include methane digestion, use of additives, mechanical aeration, separation in combination with a further treatment step, dehydration, and others.

Cost/benefit:
This research will be of greatest benefit to large operations using liquid manure, especially swine. The viability of the industry hinges on being able to expand and build these specialized units. Better solutions are required than bylaw control which will greatly hinder the competitiveness of the

industry.

Resources:

This project needs the cooperation of researchers in waste management, odour control, and economics, as well as livestock specialists, agricultural systems specialists, and livestock farmers. Lab and Farm-scale projects will be needed.

RECOMMENDATION NUMBER: 2

ISSUE: Large livestock operations on the rural environment

SOURCE: Rural Environment Engineering Subcommittee

OASCC LINKAGE:

TARGET AGENCY: Agriculture & Agrifood Canada - Eastern Region
Agricultural Research Institute Of Ontario
Canada Committee on Animals
MOEE

TO EVALUATE AND QUANTIFY THE IMPACT OF LARGE LIVESTOCK OPERATIONS ON THE RURAL ENVIRONMENT.

Details:
A comprehensive study is required to evaluate and quantify the impact on the environment by large livestock operations. Items that must be studied are:

1. odours from the buildings
2. odours from the manure storage
3. odours from spreading large volumes of manure
4. impact of manure transport on public roads
5. ability to handle large quantities of manure and the time required
6. volumes of water used and possible impacts on ground water supplies
7. effects of concentration of livestock facilities in an area versus spot development
8. do MDS formulas adequately assess odour potential of large livestock units

Background:
Increased competitiveness in the global marketplace has encouraged the development of very large, highly efficient livestock facilities. One facility can replace 10-20 old "farmsteads" in both animal numbers and corresponding feed requirements and manure production. Communities and involved government agencies are struggling with developing means to encourage the investment and job placements associated with these facilities while ensuring that environmental issues are adequately addressed. Concerned neighbouring residents request information and assurances but neither are available. Ontario's experience with impacts of large operations is limited. Large swine operations are the primary target of late. This trend is likely to spread to other livestock types in the future. Also, the water needs of these large operations are such that there may be an impact on neighbouring water user's supplies. Answers should be obtained before water supplies are stressed or depleted.

Cost/benefit:
Proper guidelines and possibly rules need to be developed so that communities can feel confident

that environmental issues are properly addressed. Ideally, the guidelines or rules should be similar across all communities so that location of facilities can be based on other issues rather than individual community environmental acceptance. Decisions if made now would be based on subjective rather than objective information.

Resources:

This project spans many fields of expertise from waste management specialists to hydrogeologist to rural community advisors.

RECOMMENDATION NUMBER: 3

ISSUE:	Improved systems for applying manure
SOURCE:	Rural Environment Engineering Subcommittee
OASCC LINKAGE:	
TARGET AGENCY:	Agriculture & Agrifood Canada - Eastern Region Agricultural Research Institute Of Ontario Canada Committee on Natural Resources

TO DEVELOP IMPROVED SYSTEMS FOR APPLYING MANURE TO THE LAND MORE ACCURATELY, COST EFFECTIVELY, AND WITH FEWER ODOURS.

Details:
Research should be oriented towards developing techniques to accurately apply manure both solid and liquid in a cost effective manner. Nutrient management plans are requiring low rates of application and equipment is not available to accomplish the task.

Background:
Farmers are under much more pressure to complete nutrient management plans but if they need to apply manure at low rates (less than 4000 gal/ac.), equipment is not available to accomplish this task with the accuracy needed. Some work has been done in this area recently but it was aimed at accurate application of only liquid manure and it involves dropping manure on the surface. There is also a need to address odour reduction and reduction in nutrient losses during spreading through equipment design changes.

Cost/benefit:
Society will gain through better management and nutrient application control. The farmers will gain by being able to implement nutrient management plans and save on fertility costs.

Resources:
Waste management specialists would be required for the field scale evaluation and design of manure application systems. An agricultural economist should be consulted to determine what economic gains could be achieved.

RECOMMENDATION NUMBER: 4

ISSUE:	Water contamination in agricultural watersheds
SOURCE:	Rural Environment Engineering Subcommittee
OASCC LINKAGE:	
TARGET AGENCY:	Agriculture & Agrifood Canada - Eastern Region Agricultural Research Institute Of Ontario Canada Committee on Natural Resources MOEE

TO IDENTIFY SOURCES OF WATER CONTAMINATION IN AGRICULTURAL WATERSHEDS AND PUT INTO PERSPECTIVE THE VARIOUS CONTRIBUTORS.

Details:

A comprehensive study is needed to examine all sources of water contamination in agricultural watersheds and put into perspective the relative contributions of the various sources. This should focus on surface water quality but could be applied to groundwater as well. Key indicators would include: suspended sediment, nitrate-N, BOD, E. Coli bacteria, total P, Cryptosporidium, giardia, and others. Practices to consider would include:

1. Farm practices such as: tillage, nutrient management, manure storage and spreading, livestock pasturing, crop rotation; and
2. Non-farm practices such as road construction and maintenance, rural septic system use, municipal sewage treatment plant scheduled and unscheduled releases, other spills, wildlife, etc.

Background:

Research effort in the past has been directed at individual farm practises (such as manure spreading) and examining water quality impacts, then recommending changes in farm practices to reduce the potential for water quality impairment. A considerable amount is known about the water quality impacts of many of these individual farm practices. What is not well understood is the big picture - what the relative contributions are of many activities in a watershed to the overall water quality of the watershed. In these times of limited financial resources to solve environmental problems we need to be able to target the practices that are having the greatest impact. For example, if the sediment loading in a watershed is unacceptable and if the greatest loadings are caused by poor practices of ditch construction and repair, we should not direct all our efforts toward further reducing soil erosion. Similarly, if the bacteria loadings are found to be split between animal and human sources, we should direct more effort (compared to current levels) into identifying the pathways and preventing the human contributions.

Ultimately, the most useful result of this research would be a comprehensive computer program that would consider many factors and could be used to model loadings and identify most likely

sources of contamination and most cost effective education/prevention efforts. Models are in the process of being developed or adopted to the situation and the effort should be further supported.

Cost/benefit:

As individual farms grow in size, it is likely that more and more of the blame for reduced water quality will be directed to farmers, whether warranted or not. Municipal controls will become stricter, especially on livestock farming. Being able to avoid some of the speculation on contamination sources and address the real problems may help avoid laws based on more emotion than fact. This could have a profound impact on whether a farm operation can even establish or expand in a given municipality.

RECOMMENDATION NUMBER: 5

ISSUE:	To develop a standardized test for manure odour-reducing additives
SOURCE:	Rural Environment Engineering Subcommittee
OASCC LINKAGE:	
TARGET AGENCY:	Agriculture & Agrifood Canada - Eastern Region Agricultural Research Institute Of Ontario Canada Committee on Animals

TO DEVELOP A STANDARDIZED TEST FOR MANURE ODOUR-REDUCING ADDITIVES.

Details:
This project involves an examination of what evaluation procedures are in place and develop a standardized test procedure to evaluate the effectiveness of these additives. Testing must be "realistic". First level testing may be in small vessels in lab for initial screening process but must also include field scale testing in larger tanks outside where manure is added on a continuing basis through variable seasonal conditions.

Background:
Many additives are now on the market-some are enzymes, some are masking agents, some change the pH, some are bacterial in nature, some may be feed additives, and affect digestion, etc. Some work has been initiated in the US by Bundy, some in Montreal by Suzelle Barrington, and some is currently underway by the Prairie Swine Centre. Odours are still identified as the main reason for the resistance to large livestock operations. There is a need to advance the techniques and coordinate the test procedures with other researchers so all products are evaluated in a similar manner. Testimonials are not acceptable.

Cost/benefit:
This research will be of to all livestock operations but especially to large the swine operations using liquid manure. In some cases, whether these farms can effectively control odours may determine their ability to expand or establish a new facility in an area as bylaws become more and more restrictive.

Resources:
This project needs the cooperation of researchers in waste management, odour control, and economics, as well as livestock specialists, agricultural systems specialists, and livestock farmers. Farm-scale projects will be needed though lab-scale projects may be appropriate for initial evaluation of manure additives.

RECOMMENDATION NUMBER: 6

ISSUE:	Urban wastewater treatment technologies for their applicability to the agro-industry
SOURCE:	Rural Environment Engineering Subcommittee
OASCC LINKAGE:	
TARGET AGENCY:	Agriculture & Agrifood Canada - Eastern Region Agricultural Research Institute Of Ontario Canada Committee on Natural Resources MOEE

TESTING AND ADAPTING URBAN WASTEWATER TREATMENT TECHNOLOGIES FOR THEIR APPLICABILITY TO THE AGRO-INDUSTRY.

Details:

A systematic research and development work for the adaptation of treatment processes found in urban and industrial centre to rural areas is necessary as the agrifood industry is under pressure to meet increasingly stringent environmental standards.

Background:

Applying liquid waste on agricultural land is, for many rural industries such as canneries, the best option in rural areas, but it is often not possible because of lack of land or odour problems as well as climatic considerations. There is now a growing pressure for the rural industries to rely on technologies found more often in urban industrial areas such as activated sludge systems and trickling filters. Because there often exist some land for irrigation, if not enough, near these rural industries certain steps of wastewater treatment processes found in urban areas, such as nutrients removal and chlorination, may be omitted at a great saving to the agro-industry. This must be the subject of studies based on an in-depth knowledge of biological, chemical and physical treatment processes.

8.0 SUMMARY OF DISTRIBUTION OF RECOMMENDATIONS

8.1 LIVESTOCK ENGINEERING

To Agency(ies)

Recommendation	AAFC	ARIO	CC	CARC	OMAFRA	OTHER
1. Livestock Building Design, Construction and Husbandry Systems Relationship to Antimicrobial Resistance, Human and Animal Health		X	X	X		
2. Air quality in livestock buildings		X	X	X		
3. Corrosion And Deterioration Of Agricultural Building Components		X	X	X		
4. Ice Pressures For Manure Tank Design					X	

8.2 FOOD ENGINEERING

	To Agency(ies)					
Recommendation	AAFC	ARIO	CCF	CARC	OMAFRA	Other
1. Improved technologies for pasteurization such as non-thermal processes to reduce processing cost and to enhance nutritional and flavour quality, and shelf life		X			X	
2. Baking and frying processes modelling to improve baked and fried products' quality	X	X			X	
3. Image processing for inexpensive in-line methods for detection of glass pieces in glass containers, chicken bones in mechanically deboned chicken and sclerotia (black fungus) in beans	X	X			X	
4. Development of efficient methods for separation, purification and concentration of neutraceuticals from various sources (soybean, tomato, hemp, etc.)	X	X			X	
5. In-line sensors for microbial detection, moisture at high temperature for baked foods and dough properties	X	X	X		X	
6. Raw material characterization for food product quality	X	X	X		X	
7. Optimizing material handling in wine industry	X	X	X		X	

8.3 RURAL ENVIRONMENT ENGINEERING

	To Agency(ies)					
RECOMMENDATION	**AAFC**	**ARIO**	**CC**	**CARC**	**OMAFRA**	**OTHER**
1. Investigate methods to reduce livestock manure odours	x	x	x			
2. To evaluate and quantify the impact of large livestock operations on the rural environment.	x	x	x			MOEE
3. To develop improved systems for applying manure to the land more accurately, cost effectively, and with fewer odours.	x	x	x			
4. To identify sources of water contamination in agricultural watersheds and put into perspective the various contributors.	x	x	x			MOEE
5. To develop a standardized test for manure odour-reducing additives.	x	x	x			
6. Testing and adapting urban wastewater treatment technologies for their applicability to the agro-industry.	x	x	x			MOEE

APPENDIX I

SUBCOMMITTEE REPORTS

1) Livestock Engineering Subcommittee

2) Food Engineering Subcommittee

3) Rural Environment Engineering Subcommittee

ONTARIO LIVESTOCK ENGINEERING

RESEARCH AND SERVICES COMMITTEE

1999 ANNUAL REPORT
TO

ONTARIO AGRICULTURE AND FOOD

ENGINEERING

RESEARCH AND SERVICES COMMITTEE

DECEMBER 3, 1999

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EXECUTIVE SUMMARY

The Livestock Engineering Sub-Committee of the Ontario Agriculture and Food Engineering Research and Services Committee has listed the research and service needs of Ontario for 1999.

The following items require a high priority:

Livestock Building Design, Construction and Husbandry Systems Relationship to Anti-microbial Resistance, Human and Animal Health: The use of antibiotics in animal production has been linked to the development of antimicrobial resistant bacteria that cause disease and death in humans. To protect human health, authorities in Denmark and Sweden banned the use of antibiotics for disease prophylaxis and growth promotion in animals. However, the same officials strongly recommended correcting the deficiencies in housing and husbandry systems before banning the subtherapeutic use of antibiotics. Corrections to housing and husbandry are critical first steps to avoid sickness, death, compromised animal welfare, and lost productivity in livestock farming without subtherapeutic antibiotics.

2. **Air Quality in Livestock Buildings**: Manure odours and gases, dust and dirt, and noise all contribute to the negative perception of air quality in livestock barns for both the animals and the farm workers. Poor air quality has been verified by the excessively high levels of chronic respiratory problems observed in farm workers. Poor air quality is one of the main causes of high labour turn over on livestock farms. Hazardous gases, including silo gas, hydrogen sulphide gas and carbon dioxide have on occasion accumulated to toxic levels and caused fatalities to humans and/or farm animals. Unfortunately, these gases can develop very quickly or go unnoticed until it is too late. Losses of farm animals (particularly swine) continue to occur all too often. It is also expected that there are numerous cases of injuries to the lungs of both humans and animals from sub-lethal levels of these noxious gases.

3. **Corrosion and Deterioration of Agricultural Building Components**: Steel reinforcing in silos, manure tanks and slats, as well as corrosion and deterioration of other building components can cause injury or loss of human life and livestock fatalities as well. This item includes buildings that enclose high humidity and corrosive environments (eg. composting operations). Ultimately, the National Farm Building Code may specify situations where specialized materials or coatings should be used. It is important to form partnerships with industry to fund and carry out this research.

4. **Ice Pressures for Manure Tank Design**:
The 1995 National Farm Building Code specifies that "manure storage tank walls shall be designed to withstand anticipated horizontal ice pressures". Suggested design values originated in the Quebec City area (Laval University). OMAFRA and the University of Guelph have carried out surveys of several southern Ontario sites during the winters of 1994-95 and 1995-96. Results indicated much less ice occurring in Ontario's less severe climate. It is important to publish the results of the ice build-up survey in manure tanks in Southern Ontario and to publish design information that will provide direction for concrete tank designers in Ontario. Examples of total tank failures due to ice build-up exist in other provinces. Manure tank failures can lead to important human safety and environmental issues.

INTRODUCTION

This report is a summary of the discussions held by our sub-committee, on October 19th, 1999, Shurgain Research Farm, Burford, ON. At that time current research was reviewed, new areas of concern were noted and a listing of research and service needs in the livestock engineering area were organized.

SUB-COMMITTEE ACTIVITIES:

Activities: During the past year, we have had one meeting of this sub-committee. Attending this meeting were: Members: John Johnson (Chair), Fred Groenestege, Harry Huffman (Sec.), Dr. Jan Jofriet, Dr. Neil Anderson, Bob Robson and observer: Harold House. Paul Brine was not able to attend due to other commitments.

Committee Membership: Bob Robson, Manager of the Shur-gain Agresearch Farm near Burford has agreed to participate as a member of our committee. Eugene Asnong, a farm building equipment sales person, agreed to participate on this committee last year, but has since moved his employment to Western Canada. Gary VanBolderen, CFBA member has indicated a desire to be removed from this committee. Harry Huffman is anticipating a retirement from his current position within the next year so will be resigning his post as secretary. David Kloosterman has been a member for more than three years, therefore his term has been completed.

Several names were suggested as possible future members for this committee. They included; David Waud (Sun-North Systems), Murray Gould or Paul Fallis (BSM Agri Ltd.), Ray Jacobs (Landmark Builders Ltd.), Ron MacDonald (Agviro Inc.).

Review of Current Listing:

John Johnson and Harry Huffman attempted to carry out a review of the current listing without a face-to-face meeting of the committee. It became clear that this would not suffice. Therefore at a meeting at the Shur-Gain Research Farm, the following items were discussed:

Construction Concerns with Manure Storage - Discussion was held about the need for the entire manure handling system including the plumbing connections to be "water tight". Currently section 2.2.1.13 of the National Farm Building Code only discusses the construction of manure tank walls and tops.
Action: *It was agreed that John Johnson, and Jan Jofriet would look at this section in more detail and suggest some clarification on the wording and/or expand the definition of manure storage system. Fred Groenestege and Harold House would also like the opportunity to comment.*

Corrosion of Truss Gusset Plates - In November 1997 our committee requested a new clause be added to the National Farm Building Code requiring all metal truss gusset plates to be protected by a suitable coating when used in a corrosive atmosphere. In April 1998 the Standing Committee on Structural Design replied that the matter warranted some action but required "something more specific and enforceable than proposed by Mr. Huffman". Based on an upcoming Code meeting that Dr. Jofriet

will be attending, it is felt that our committee should respond in order to keep this concern and request for Code change active. The letter from the Code committee suggested that the Truss plate Institute of Canada be consulted to ensure that any proposed solution is achievable by the industry. As well, an official form for "Proposed Change to a National Code Document" was attached which basically asks for the wording for the change or addition and the justification for the change.
Action: *John Johnson and Harry Huffman to obtain input from the Truss Plate Institute of Canada and further this request for addition by completing the necessary paper work and re-submit to the Canadian Commission on Building and Fire Codes.*

1. **Horizontal Silo Construction Design Criteria**
   The current code contains some temporary design criteria, which does not reflect the latest research findings regarding loading and more adequate design. The problem occurs mainly with higher walls or deep piles. This committee agrees that the loading formulae in the code should be updated to reflect the latest research completed by Jan Jofriet.
   Action: *Jan Jofriet will assemble the necessary documentation and forward to our committee. Our committee will put forth the official request for change in the code.*

1. **Corrosion of Horizontal Silos**
   There was some discussion regarding the corrosion that typically occurs in horizontal silos- particularly the concrete floor. Some facilities now installing asphalt floors.
   Action: *Committee agreed that this concern is part of the existing item in our current listing (Corrosion and Deterioration of Agricultural Building Components). Possibly there should be a direct reference to bunker floors.*

1. **Animal Comfort, Care, Health/Disease**
   Dr. Neil Anderson led a discussion on the lack of concern and enforcement of poor barn design that affects animal well being and leads to poor performance, poor health and/or disease, and eventually financial ruin. Examples mentioned were; poor stall design, use of cow trainers, watering systems at improper height and barn layouts that cross contaminate manure and feed. If possible, he would like to see animal health design parameters in the building code and enforced by inspectors. Dr. Anderson would like to see stronger wording and give this issue a higher ranking on our research listing. It needs a new title and wording that will attract multi-disciplinary researchers to explore this issue on Ontario farms.
   Action: *Dr. Anderson will prepare a new submission according to the present detailed report format for the rest of the committee to review.*

INDUSTRY/SECTOR SCAN:

Major Accomplishments since last report:

Air Quality in Livestock Buildings:

- air quality in livestock buildings (Univ. of Saskatchewan - 0.1 py (person years))
- evaluation of floor applied mineral oil in reducing respiratory dust (Univ. of Alberta - 0.1 py)

Corrosion and Deterioration of Agricultural Building Components:

- corrosion and deterioration of agricultural building components (Univ. of Guelph 0.35 py)

Ice pressures for Manure Tank Design; Manure tank design:

- design criteria for cylindrical liquid manure tanks (Univ. of Guelph 0.35 py)
- Dr. Jofriet at the Univ. of Guelph continues to advance this project (time unknown)
- Innovative design of manure storage tanks (Univ. of Manitoba - 0.54 py)
- A letter to the Standing Committee on Structural Design pertaining to the wording of the National Farm Building Code is proposed. This will be forwarded to the Standing Committee in 1999.

Animal Comfort:

- A behavioural and environmental study to develop improved gestation and farrowing accommodation for sows and litters (Lennoxville, Que - 2.9 py)
- To monitor feed and water intake, nesting and sexual behaviour of broiler breeder hens in open pens (Univ. of Alberta - 0.19 py)
- poultry welfare (Guelph 0.9 py)
- Using natural convection to lower attic temperatures in controlled environment buildings (Univ. of Manitoba - 0.08 py)
- Investigation of installation, cost and durability of four manger surfaces in a tie-stall dairy barn (Univ. of Guelph 0.04 py)

Corrosion of Roof Truss Gusset Plates - A letter was written to the standing committee on Structural Design (National Research Committee, Ottawa) recommending that truss gusset plates that are located in corrosive environments be required to be coated in such a way that protection is offered to the steel. A letter was received from the Standing Committee requesting further information. Clarification and a letter of support from the Truss Plate Institute of Canada is forth-coming.

Technical Information for the Construction Industry:

- Structural behaviour of nail-laminated posts (Univ. of Manitoba - 0.11 py)
- Frost protection using foam (Nova Scotia Agric. College – 0.00 py)

CURRENT STATE OF THE INDUSTRY/RURAL SECTOR:

Beef:
- the Ontario beef industry continues to have it's ups & downs
- much of the cattle feeding is done on contract
- there are not a lot of new barns being built; however there continues to be some feeder barns (200 - 500 head)

Dairy:
- optimism in the industry remains
- the price of quota continues to rise - $17,000/kg of butterfat
- barns continue to be constructed, both by immigrant producers, and established producers
- North America's first commercial robotic milking installation started operation near Plattsville in March. Two farms are now operating exclusively with milking robots, two more are scheduled for installation in September, and possibly two more by December. The two companies offering robots for sale are Lely, and Prolion

Swine:
- barns continue to get bigger in size: 2400 sow barns and 2000 finishing barns are becoming the norm
- society's reaction to proposed swine barns being built is getting much more vocal and organized including legal battling
- municipalities are reacting with restrictive by-laws in an attempt to minimize 'large' barns

Sheep and Goats:
- sheep production is increasing slightly, some as milking herds
- there is a continued increased interest in goat operations.

Poultry:
- producers continue to be very optimistic about this industry and seem prepared to invest big dollars in quota and new facilities. Interest continues to come from older dairy farmers who are switching between the two quota systems. Extremely high quota prices continue (broilers @ $38/unit; egg quota @ $78/hen; turkeys @ $2.60/kg).
- starting in the fall of 98, a new export production policy has allowed additional placement of broiler chickens that is providing optimism for some more growth in this sector. Quota transfers were halted this summer while the board developed a new policy for additional quota allocation.
- the imported hatching egg supply was very tight during 98-99 and resulted in substantially increased prices from U.S. suppliers. This cost was further compounded by our low Canadian dollar. The result has been flock life extensions in an attempt to cover the short fall.
- Ontario has approximately: 1100 broiler producers; 200 pullet producers; 500 egg laying hen producers; and 160 turkey producers.

Fruit and Vegetables:
- the season was 10 days earlier in most areas, but very dry in the main horticultural areas. Those with irrigation prospered and had excellent crops.
- there have been few storages built in past year except for a few potatoes and carrots
- the greenhouse industry continues to expand frantically, particularly in the Leamington area (cucumbers and tomatoes) and in Niagara (flowers)

- non-traditional niche-market crops are being grown with unfamiliar post-harvest requirements

Grains and Forages:
- construction of tower silos remains at an all time low
- silo deterioration continues to be an ongoing challenge
- plastic from wraps, tubes, individual bags, etc. present local problems for recycling or disposal

Building Engineering:
- building construction is relatively active in Ontario. Typically, new livestock buildings are tending to be very large. Engineering is more prevalent in these larger structures. A larger contractor may have an on-staff engineer or may hire a private consultant to provide engineering details. Building officials are happy to share some of the responsibility for the structure with an engineer.
- municipal restructuring will eventually result in fewer, better trained building officials. There were over 800 municipalities in Ontario; we're down to 500+ right now and expect to be in the range of 350 by 2003. This will bring about more even application of building codes in Ontario. OMAFRA is battling irregular application of building codes.

Environmental:
- while slightly down from last year, a large number of swine, poultry and dairy operations are still being constructed in Ontario. Two large swine facilities were found to be leaking manure into field tiles that were left directly below the structures during construction.
- odours from mushroom composting operations may prove to be the industry's downfall. One case currently in the courts is considering damages to neighbours whose property rights have been infringed upon.

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EMERGING ISSUES:
- **preventing manure leakage from barns and storages**
- **challenges of perception regarding on-farm antimicrobial resistance**
- **manure handling problems when sanding bedding is used in free-stalls**
- **power driven nails do not have the shear strength or holding power of spiral and common nails.**
- **increase in tarp type buildings for hay storage and cattle housing**
- **management of deep (7-8') bedded manure pack beef barns**
- **interest in 'greenhouse' barns for calves, heifers and free stall barns continues**
- **corrosion of farm building components**
- **animal care and comfort: base and bedding, feed barriers, stall designs, and flooring**
- **use of cow mattresses: rubber filled; heavy sponge-rubber (concerns with stretch)**
- **interest in full curtain walls for dairy; usually a split wall design where the top part is not insulated and the bottom portion is insulated**
- **wider, single storey poultry barn are challenging conventional ventilation systems**
- **air quality in swine barns: health of workers; high manure gas levels during agitation**

- **poultry producers are considering the installation of foggers and/or misters to achieve some evaporative cooling**
- **disease control on new large swine operations**
- **covered manure storages for poultry**
- **more cold storages will be used year round to spread out costs. This may create some vapour barrier problems with reversing vapour pressure gradients**
- **aeration systems for flat grain storages**
- **producers believe there is a need for research to provide information and technology to prevent or alleviate concerns regarding animal welfare and environmental sustainability in all sectors.**
- **question the typical design of knee-braced joints for shear loading**
- **questions still remain regarding the use/operation of tunnel ventilation systems**
- **animal care and welfare issues are becoming more common**
- **barn air quality is still an issue**
- **what depth of manure storage under a barn floor is acceptable?**
- **what is the real value or importance of insulation under the floor of a poultry barn?**
- **what effect or impact will the Y2000 date problem have on livestock buildings and equipment, eg. feeding, ventilation/heating**
- **time commitment, and type of cleaning equipment being recommended for cleaning barns between animal cycles. There is some speculation on the use of robotics for this task**
- **Corrosion of farm building components continues to be a problem**
- **Need to design manure tanks for ice pressure**

New Ideas for Research and Service:

- Require information regarding the strength of nailed joints
- Require information regarding the factors that affect tunnel ventilation
- Require information regarding the effectiveness of floor insulation
- Require information regarding the effectiveness of various heating systems for "the same" animal comfort (specifically in SEW swine barns)
- Would like to have increased fan and controls testing by an independent testing agency
- Require increased odour control research for both inside barn air quality as well as around the buildings
- Committee members felt that the agricultural sector needs to become more proactive in the environment area. Recommends this committee pass on this comment to the Rural Environment Committee
- would like to see Canada Plan Service concept drawings, but not engineering design information
- would use Canada Plan Service for technology transfer and sharing new concepts
- ventilation information and details would be useful, as would manure handling info
- beef producers need to be able to lower costs of production by 20%. Simplified structures would assist. Some features might be modular construction, a roll-off roof, combination manure systems

- there are a few cases of human tapeworm disease in beef cattle. HACCP programs should consider this type of problem.

REPORT OF ACTION TAKEN ON PREVIOUS RECOMMENDATIONS:

Responses from ARIO; OMAFRA; AAFC; Others:

Improvement of air quality in and around livestock buildings will help to improve the health and well being of both livestock and farmers as well as improving the acceptance of livestock operations in the community.

The dairy pork and poultry components of the animal program at the University of Guelph contain objectives related to improving the internal building environment. The new Agri-Food System Resources and Environment program supports research into manure handling systems which may also serve to improve the internal environment.

Maintenance of the structural integrity of farm buildings is an important component of ensuring the health and safety of farmers and livestock. Resources at present do not allow for extensive research in this area and ARIO continues to suggest that private sector partners be sought to assist with the required research and extension.

Air quality in livestock buildings.

Response: University of Guelph – The only project in the Animal program of the University of Guelph/OMAFRA Enhanced Partnership that addresses this priority is: Amelioration of odours from hog manure by electrochemical treatment. N. Bunce
There are animal scientists co-operating with systems projects in the Resources program who are addressing this priority.

Corrosion and deterioration of agricultural building components.
No Response.

STRATEGIC DIRECTIONS/PROBLEMS OR ISSUES/SECTOR PRIORITIES

- **RECOMMENDATION NUMBER: 1**

ISSUE: Animal & Human Health

SOURCE: Livestock Engineering Sub-committee

OASCC LINKAGES: Animal Committee

TARGET AGENCY: Agricultural Research Institute Of Ontario,
- Canadian Agricultural Research Council

LIVESTOCK BUILDING DESIGN, CONSTRUCTION and HUSBANDRY SYSTEMS RELATIONSHIP TO ANTIMICROBIAL RESISTANCE, HUMAN and ANIMAL HEALTH

Details: The use of antibiotics in animal production has been linked to the development of antimicrobial resistant bacteria that cause disease and death in humans. Corrections to housing and husbandry are critical first steps to avoid sickness, death, compromised animal welfare, and lost productivity before antibiotics become less available. The antimicrobial resistance - human health issue will drive the banning of antibiotic growth promotant products sooner than most might expect. Livestock producers need to know what renovations to make to existing animal husbandry units and what features to build into new units to prepare for the inevitable ban.

Research is needed:

to identify the design, construction and husbandry systems in livestock buildings that compliment high livestock health and performance without the use of antibiotic growth promotants or the subtherapeutic use of antibiotics. (Conversely, to identify the design, construction and husbandry systems that contribute to disease and impaired performance that require the use of subtherapeutic antibiotics.)

to develop practical and economical designs and construction methods for renovating existing buildings or building new structures to enable high livestock health and performance.

to develop practical and economical modifications to existing husbandry systems or create new husbandry systems within livestock buildings to enable high livestock health and performance.

To identify and/or develop practical and economical design, construction and husbandry systems that minimize disease transmission. (Conversely, to identify design, construction and husbandry systems that contribute to the spread of infectious diseases.)

Funding is needed:

To create a centre for livestock husbandry planning to enable dialogue between scientists

in the disciplines of engineering, waste management, nutrition, veterinary medicine, economics, and human medicine (to name a few) directed at livestock housing systems, animal and human health, and the reduction of the use of antimicrobial products.

To enable the creation and implementation of a national strategy focused on livestock buildings and husbandry systems to reduce the use of subtherapeutic antibiotics.

To enable the development of national standards in housing, construction and husbandry systems focused directly at ensuring high livestock health and performance without the use of subtherapeutic use of antibiotics.

To enable validation of the above mentioned national standards on Canadian farms.

Background: Historically, owners, veterinarians or feed company personnel reach for antibiotics for treatment, prevention or growth promotion. Too many livestock housing and husbandry systems have compromises leading to contamination of feed and water with manure, exposure of young stock to manure from adults, excessive humidity, and poor air quality, as a few examples. These compromises lead to unnecessary animal stress, bacterial load in the animal environment, exposure and challenges to infectious agents, and disease requiring treatment or prevention with antibiotic therapy. Efforts to optimize the design, construction and husbandry systems at the outset would and could negate the need for antibiotic therapy in the future. To minimize the use of subtherapeutic antibiotics in livestock production, livestock producers need to build appropriate housing and husbandry systems.

Unfortunately, Canada does not have any codes regulating building and husbandry system characteristics that compromise animal health, necessitate the need for subtherapeutic antibiotic therapy, or ultimately pose a risk to human health through development of antimicrobial resistant bacteria following this use of antibiotics. Some research is needed to quantify the influence of livestock housing in Canada on livestock health and performance. The Canadian and international literature needs to be reviewed and knowledge gaps identified. In addition, we need to quantify what facilities and systems contribute to high health and those that do not. We need this information for risk assessment purposes prior to implementing an antibiotic ban.

Cost/benefit: Reports from Sweden show increased sickness, death and lost production following the ban of antibiotic growth promotants or the use of antibiotics at subtherapeutic levels. However, after altering livestock building characteristics and husbandry systems, health and performance returned to levels equal to or greater than those achieved with antibiotic use. One might conclude then that antibiotic use is a Band-Aid for deficiencies in housing and husbandry systems, and an unwarranted on-going cost of production. Denmark attended to the housing systems prior to the antibiotic ban and did not experience the health and performance problems seen in Sweden. In both countries, surveillance shows a decrease in frequency of antimicrobial resistant bacteria. Both countries believe there is a definite benefit to human health and health care systems from banning the subtherapeutic use of antibiotics.

RECOMMENDATION NUMBER: 2

ISSUE: Air Quality in Livestock Buildings

SOURCE: Livestock Engineering Sub-Committee

OASCC LINKAGES: Animal Committee, Soil Water and Air Committee

TARGET AGENCY: Agricultural Research Institute Of Ontario
Canadian Agricultural Research Council
Agriculture & Agri-Food Canada

AIR QUALITY IN LIVESTOCK BUILDINGS

Details: Manure odours and gases, dust and dirt, and noise all contribute to poor air quality in livestock barns for both the animals and the farm workers. Poor air quality has been verified by the excessively high levels of chronic respiratory problems observed in farm workers. Air quality is one of the main causes of high labour turn over on livestock farms. Hazardous gases, including silo gas, hydrogen sulphide gas and carbon dioxide have on occasion accumulated to toxic levels and caused fatalities to humans and/or farm animals. It is also expected that there are numerous cases of injuries to the lungs of both humans and animals from sub-lethal levels of these noxious gases.

Research is Needed:

1. To study means of reducing the level of air contaminants found in barn environments.
To develop improved manure storage systems and management, handling, processing and disposal to reduce hazardous gas generation and minimize odour problems.
To determine the chronic effects of sub-lethal gas levels on both humans and livestock and evaluate the long term effects of exposure to these hazardous gases.
4. To determine the short and long term effects of barn noise on both humans and livestock.

Applied Research is Needed:

5. To agree on practical and achievable Threshold Limit Values (TLV) for the various air pollutants and combinations of same encountered inside farm buildings.
To measure the effect of various additives to the barn environment, feed or manure gutters on subsequent air quality and odour control.
7. To study under-floor ventilation with regard to improved odour control in the animal environment.
7. To develop a thorough evaluation and testing program for warning devices which alert farm personnel that one of the hazardous gases is at a dangerous level.
8. To develop appropriate and practical information for dealing with hazardous gases found at dangerous levels in the animal environment or feed storage area.

Background: Work is still required to develop appropriate strategies for dealing with the various air pollutants, odours and noise levels found in livestock barns. Today's farm workers spend most of their time inside livestock buildings, feed and grain storages as well as operating noisy machinery. They are exposed to high concentrations of different organic dusts such as grain dust, animal epithelia, hair, proteins from urine and feces, mites, bacteria, endotoxin and mold spores. Also, these particles are associated with various toxic gases such as ammonia, hydrogen sulphide, carbon monoxide, etc.
Several of these toxic gases are either odourless or have the ability to paralyse the nervous

system and thus are hard to detect when present at harmful concentrations. As farming operations become larger, more hired labour is employed and this increases the chance of short-cuts or misunderstood safety procedures. With several gases involved, more than one warning device may be needed to cover all of the needs of a particular environment. Any such warning device must be reliable over time when located in such a harsh building environment. This type of gas sampling equipment already exists but needs to be evaluated and/or adapted to suit the specific needs of animal environments. Cost will be an important factor in convincing farmers to install these devices. Many producers inquire about chemical additives to the feed, water or manure storage which might reduce odours and toxic gases. Some work is being done by Agriculture Canada, Ridgetown Agricultural College, University of Saskatchewan and Iowa State University, however much is still unknown about the effectiveness of these additives. There may be opportunities for gas and odour reduction within the animal environment with alternative manure handling, processing and disposal systems. There is no known work in this area.

Cost/Benefit: From research work done in Europe and the USA, it has been estimated that 25% to 40% of all the livestock producers and their family members, as well as their farm workers suffer to varying degrees from bronchitis, occupational asthma, organic dust toxic syndrome or general irritation of mucosal membranes due to the poor air quality inside livestock buildings. Applying this estimate to Ontario, there would be between 30,000 and 50,000 people suffering from poor indoor air quality on dairy, beef, swine and poultry farms. It is extremely difficult to evaluate the cost to society because of a reduction of productivity by workers' absenteeism and medical care services directly related to barn air quality. Additionally, it is impossible to assess the cost or loss of revenue encountered by producers because of the difficulty in recruiting, training and maintaining reliable farm workers.

The presence of toxic gases is a human and animal safety issue that is difficult to quantify in dollars. If some animals are killed due to exposure to H_2S gas, not only is there the direct animal losses, but also the down time while another group of animals is raised on farm or purchased to replace those lost. Manure gas, silo gas and carbon dioxide (sealed silo) have all claimed human lives on farms. What is the value of a human life? If a simple gas detector could be marketed for a reasonable cost, along with a proven procedure for reducing hazardous gas levels, it would significantly reduce the number of animal and human respiratory injuries and possible fatalities.

Resources: The University of Guelph, Prairie Swine Research Centre, University of Alberta and University of Saskatchewan have all done some work with air pollutants in livestock buildings but much more work is required. An interdisciplinary task force of agricultural engineers, researchers, veterinarians, physicians and occupational health specialists should be assembled to address threshold limit values for indoor air contaminants, odours and noise levels in farm buildings.

Both Agriculture Canada and OMAFRA have done some research and extension in the areas of manure and silo gas. As well, the University of Guelph, OMAFRA, Prairie Swine Research Centre and the University of Saskatchewan have all done some studies on air contaminants and dust in livestock environments. More needs to be done with commercial scientific instrument companies that already market gas detection equipment. Similarly, it may be possible to co-operate with chemical or feed companies regarding the potential for additives.

RECOMMENDATION NUMBER: 3

ISSUE: Corrosion of Metal Building Components

SOURCE: Livestock Engineering Sub-Committee

OASCC LINKAGES: Animal Committee, Horticultural Crop Committee

TARGET AGENCY: Agricultural Research Institute Of Ontario,
Canadian Agricultural Research Council
Agriculture & Agri-Food Canada

CORROSION AND DETERIORATION OF AGRICULTURAL BUILDING COMPONENTS

Details: Corrosion problems are evident in some farm structures that could affect their structural integrity. Reinforcing steel in cast-in-place silos and beef and swine floor slats have shown deterioration which could lead to structural failure. In under-floor manure storage structures, manure gas and other air contaminants are accelerating the corrosion and deterioration of all metal components and building equipment. Composting structures are showing corrosion on unprotected metal components after a relatively short time. Also, it appears that some wood preservatives hasten corrosion of the structural fasteners used to connect building members.

Research is Needed:

1. To study the relationship between various odours and gases and moisture levels found in typical livestock environments (also composting structures) and the amount of corrosion occurring on the metal building components.
2. To determine the relationship between various wood preservatives and the amount of corrosion occurring on the metal fasteners connecting these members in a farm building.
3. a) To determine the feasibility of using a steel coating and/or concrete additives to inhibit the corrosion of reinforcing steel in such adverse situations as slatted floors, silos and manure storage.
   b) To determine the feasibility of using concrete sealants and coatings that may reduce concrete deterioration which in turn will protect the reinforcing steel.

Background: Silage juices and liquid manure are able to attack the concrete and over time penetrate to the reinforcing steel which in turn corrodes very quickly. The agricultural industry needs a more durable concrete product. Should coated reinforcing bars, concrete additives, coatings and sealants be used, alone or in combination? Concrete slat deterioration has become a significant problem.

The combination of various gases along with higher humidity levels found in livestock barns tend to corrode all metal components of the building and equipment. Proper ventilation plays a role, but to what extent? A field study by OMAFRA revealed that almost half of the livestock buildings investigated had moderate to severe corrosion occurring on the metal gusset plates.

Wood preservatives have been used with good success to protect the building members from deterioration. Concern has now been raised that some preservatives seem to cause an accelerated corrosion of the metal fasteners connecting these treated members in a typical farm building. The farm building industry needs to know which preservatives should be

recommended or whether the fasteners need to be coated to prevent this corrosion process.

Cost/Benefit: In 1994, the cost of depreciation on all Ontario agricultural structures was $234.2 million. As well, $130.24 million was spent on building repairs. Since agricultural structures may need to be repaired or replaced prematurely because of this deterioration, these costs could be substantial. On average, corrosion could account for a 10% loss of expected building life. It is estimated that the value of Ontario farm buildings is $10 billion and the average life expectancy of a farm building is 25 years. As a result of corrosion, if the building lasts for only 22.5 years, this results in an annual cost of $44 million.

Livestock housing costs account for 10-20% of the total cost of production. Any shortening of the service life will increase these costs. In addition, if there is a structural failure, there may be additional financial hardship and potential for both human and animal injury or fatality. It is unlikely that any research recommendations concerning suitable coatings, sealants or concrete additives would increase overall building construction costs by more than 5%. If the value of agricultural structures in Ontario is $10 billion, and their life is 22.5 years, approximately $444 million is spent on new construction annually. If the cost to resist corrosion in these structures is 5 percent, this would amount to an annual cost of $22 million.

Therefore the cost/benefit ratio is 22/44 = 1:2

Resources: O.M.A.F.R.A. has evaluated several coatings for use on concrete silo walls. All Ontario concrete slat manufacturing plants are now certified by CSA which should ensure a quality slat for all new buildings. Concrete slat manufacturers are promoting several different approaches to providing increased durability. It is important for cooperative research to take place with these manufacturers. Additionally, the steel industry has good data available on coated reinforcing steel and may wish to collaborate on this type of work. Similarly, the steel industry should expect to work with researchers and the chemical industry to establish recommendations concerning the use of various coatings on metal components in corrosive environments.

RECOMMENDATION NUMBER: 4

ISSUE: Ice Pressure and Structural Design

SOURCE: Livestock Engineering Sub-Committee

OASCC LINKAGES:

TARGET AGENCY: The Ontario Ministry of Agriculture, Food and Rural Affairs

ICE PRESSURES FOR MANURE TANK DESIGN

Details: Based on the findings of field surveys in the winters of '94-'95 and '95-'96, OMAFRA standard designs for cylindrical tanks were redesigned for 0.2 m, 0.4 m and 0.6 m design ice thickness. After further consideration of the various climatological regions of Ontario recommendations will be made for use of one of these three designs.

Service is needed:
1. To publish the results of the ice build-up survey of manure tanks in Southern Ontario.
2. To publish design information that will assist concrete tank designers in Ontario.

Background: The 1995 National Farm Building Code (NFBC) specifies that "manure storage tank walls shall be designed to withstand anticipated horizontal ice pressures". In an appendix, the Code states that these pressures may reach values of 50 kPa acting over a height of 0.5 m at the level of the liquid. This value originated in the Quebec City area (Laval University). No values are available for Ontario'sless severe climate, especially in the south where most liquid manure tanks are built.

Shelley Bonte-Gelok, a fourth year engineering student at Guelph, carried out a second field study during December, 1995 to March, 1996 to measure the extent of ice build-up in manure tanks. The dozen tanks examined were about the same as those in the field study of the previous winter. Although the 95-96 winter was closer to "normal" than 94-95 there was no evidence found of ice damage to tanks. Ice thicknesses in Southern Ontario were found to be 0.2 – 0.3 m rather than the 0.5 m mentioned in the NFBC.

Cost/Benefit: The additional design loading recommended by Laval University had the potential to cost farmers additional dollars in the construction of their manure storage tanks. As yet, the increased cost is unknown. The results of this project will allow farmers to continue building cylindrical liquid manure tanks in most agricultural areas without any substantial increase in cost. Only in the very coldest regions of Ontario will the standard designs have to be strengthened to allow for the substantial ice pressures that will occur in those regions. A 100 ft. (diameter) x 12 ft. (depth) concrete manure storage tank costs approximately $40,000. A failure of this tank will result in a loss of that value plus associated cleanup costs and possible environmental damage. Clean-up costs are variable but typically could approach $20,000 in this type of failure. In extreme cases, the additional reinforcing required could result in a 15% increase in initial cost. Therefore, the cost/benefit ratio is $6000/$60000 = 1:10

Resources: Dr. Jofriet, University of Guelph and J. Johnson, OMAFRA will work together to produce the appropriate documents. Dr. Jofriet has produced additional information in 1998 that brings the project closer to completion.

SUMMARY OF DISTRIBUTION OF RECOMMENDATIONS FOR 1999

RESEARCH AND DEVELOPMENT:

	To Agency(ies)					
Recommendation	**AAFC**	**ARIO**	**CC**	**CARC**	**OMAFRA**	**OTHER**
1. Livestock Building Design, Construction and Husbandry Systems Relationship to Antimicrobial Resistance, Human and Animal Health		X	X	X		
2. Air quality in livestock buildings		X	X	X		
3. Corrosion And Deterioration Of Agricultural Building Components						
4. Ice Pressures For Manure Tank Design		X	X	X		
					X	

APPENDIX II Subcommittee Membership 1999
(please see proposed list for 2000 at end of document)

Organization	Name	Contact Information	Term End
OMAFRA	John Johnson (Chair)	OMAFRA, 667 Exeter Rd. London, ON N6E 1L3 Ph. 519- 873-4096 Fax 519-873-4062 jjohnson@omafra.gov.on.ca	Passed expiry date
OMAFRA	Harry Huffman (Chair)	OMAFRA, 667 Exeter Rd. LONDON, ON N6E 1L3 Ph. 519-873-4082 Fax 519-873-4062 hhuffman@omafra.gov.on.ca	1999
Univ. of Guelph	Dr. Jan Jofriet	University of Guelph, School of Engineering, GUELPH, ON NIG 2WI Ph. 519-824-4120 Ext. 3642 Fax 519-836-0227 jjofriet@uoguelph.ca	2001
Private Sector	David Kloosterman	Agrotec Construction Ltd. R.R.#2, ILDERTON, ON N0M 2A0 Ph. 519-666-0453 Fax 519-666-2430	1999
Private Sector	Jim Cooke	R.R.#1 Walkerton, ON N0G 2V0 Ph. 519-881-1188 Fax 519-881-3628 redbaron@bmts.com	2000
Private Sector	Fred Groenestege	Fred Groenestege Const. Ltd. R.R.#1, SEBRINGVILLE, ON N0K 1X0 Ph. 519-393-6579 Fax 519-393-6532 fredg@fgc.ca	2000
OMAFRA	Dr. Neil Anderson	Manager, Health Management OMAFRA 2nd Floor, Wellington Place, R.R.#1 FERGUS, ON N1M 2W3 519-846-0965 Fax 519-846-8101 nanderso@omafra.gov.on.ca	2001
Shur-Gain Agresearch	Bob Robson	R.R.#3, Burford, ON N0E 1A0 Ph. 519-424-2550 Fax 519-424-2570 shurgain@oxford.net	2002

1999 COMPLETE LIST OF LIVESTOCK ENGINEERING RESEARCH AND SERVICE NEEDS (in order of priority)

LIVESTOCK BUILDING DESIGN, CONSTRUCTION and HUSBANDRY SYSTEMS RELATIONSHIP TO ANTIMICROBIAL RESISTANCE, HUMAN and ANIMAL HEALTH

The use of antibiotics in animal production has been linked to the development of antimicrobial resistant bacteria that cause disease and death in humans. To protect human health, authorities in Denmark and Sweden banned the use of antibiotics for disease prophylaxis and growth promotion in animals. However, the same officials strongly recommended correcting the deficiencies in housing and husbandry systems before banning the subtherapeutic use of antibiotics. Corrections to housing and husbandry are critical first steps to avoid sickness, death, compromised animal welfare, and lost productivity in livestock farming without subtherapeutic antibiotics.

The antimicrobial resistance - human health issue is here. It will drive the banning of antibiotic growth promotant products from farming practices in Canada sooner than most might expect. Livestock producers need to know what renovations to make to existing animal husbandry units and what features to build into new units to prepare for the inevitable ban.

Research is needed:

to identify the design, construction and husbandry systems in livestock buildings that compliment high livestock health and performance without the use of antibiotic growth promotants or the subtherapeutic use of antibiotics. (Conversely, to identify the design, construction and husbandry systems that contribute to disease and impaired performance that require the use of subtherapeutic antibiotics.)

to develop practical and economical designs and construction methods for renovating existing buildings or building new structures to enable high livestock health and performance.

to develop practical and economical modifications to existing husbandry systems or create new husbandry systems within livestock buildings to enable high livestock health and performance.

To identify design, construction and husbandry systems that minimize disease transmission. (Conversely, to identify design, construction and husbandry systems that contribute to the spread of infectious diseases.)

To develop practical and economical design, construction and husbandry systems that minimize disease transmission.

Funding is needed:

To create a centre for livestock husbandry planning to enable dialogue between scientists in the disciplines of engineering, waste management, nutrition, veterinary medicine, economics, and human medicine (to name a few) directed at livestock housing systems, animal and human health, and the reduction of the use of antimicrobial products.

To enable the creation and implementation of a national strategy focused on livestock buildings and husbandry systems to reduce the use of subtherapeutic antibiotics.

To enable the development of national standards in housing, construction and husbandry systems focused directly at ensuring high livestock health and performance without the use of subtherapeutic use of antibiotics.

To enable validation of the above mentioned national standards on Canadian farms.

To enable the inclusion into codes of national standards that foster the reduction of antibiotic use and the enhancement of livestock health (into building codes for livestock structures and codes of practice for animal care).

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2. AIR QUALITY IN LIVESTOCK BUILDINGS

Manure odours and gases, dust and dirt, and noise all contribute to poor air quality in livestock barns for both the animals and the farm workers. Poor air quality has been verified by the excessively high levels of chronic respiratory problems observed in farm workers. Air quality is one of the main causes of high labour turn over on livestock farms. Hazardous gases, including silo gas, hydrogen sulphide gas and carbon dioxide have on occasion accumulated to toxic levels and caused fatalities to humans and/or farm animals. It is also expected that there are numerous cases of injuries to the lungs of both humans and animals from sub-lethal levels of these noxious gases.

Research is Needed:

To study means of reducing the level of air contaminants found in barn environments.

To develop improved manure storage systems and management, handling, processing and disposal to reduce hazardous gas generation and minimise odour problems.

To determine the chronic effects of sub-lethal gas levels on both humans and livestock and to evaluate the long-term effects of exposure to these hazardous gases.

To determine the short and long term effects of barn noise on both humans and livestock.

Applied Research is Needed:

To agree on practical and achievable Threshold Limit Values (TLV) for the various air pollutants and combinations of same encountered inside farm buildings.

To measure the effect of various additives to the barn environment, feed or manure gutters on subsequent air quality and odour control.

To study under-floor ventilation with regard to improved odour control in the animal environment.

To develop a thorough evaluation and testing program for warning devices which alert farm

personnel that one of the hazardous gases is at a dangerous level.
To develop appropriate and practical information for dealing with hazardous gases found at dangerous levels in the animal environment or feed storage area.

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3. CORROSION AND DETERIORATION OF AGRICULTURAL BUILDING COMPONENTS

Corrosion problems are evident in some farm structures that could affect their structural integrity. Reinforcing steel in cast-in-place silos and beef and swine floor slats have shown deterioration which could lead to structural failure. In under-floor manure storage structures, manure gas and other air contaminants are accelerating the corrosion and deterioration of all metal components and building equipment. Composting structures are showing corrosion on unprotected metal components after a relatively short time. Also, it appears that some wood preservatives hasten corrosion of the structural fasteners used to connect building members.

Research is Needed:

1. To study the relationship between various odours and gases and moisture levels found in typical livestock environments (also composting structures) and the amount of corrosion occurring on the metal building components.
2. To determine the relationship between various wood preservatives and the amount of corrosion occurring on the metal fasteners connecting these members in a farm building.
3. a) To determine the feasibility of using a steel coating and/or concrete additives to inhibit the corrosion of reinforcing steel in such adverse situations as slatted floors, silos and manure storage.
   b) To determine the feasibility of using concrete sealants and coatings that may reduce concrete deterioration which in turn will protect the reinforcing steel.

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4. ICE PRESSURES FOR MANURE TANK DESIGN

Based on the findings of field surveys in the winters of '94-'95 and '95-'96, OMAFRA standard designs for cylindrical tanks were redesigned for 0.2 m, 0.4 m and 0.6 m design ice thickness. After further consideration of the various climatological regions of Ontario recommendations will be made for use of one of these three designs.

Service is needed:

1. To publish the results of the ice build-up survey of manure tanks in Southern Ontario.
2. To publish design information that will assist concrete tank designers in Ontario.

5. TECHNICAL INFORMATION TO ASSIST THE FARM BUILDING INDUSTRY

The Ontario Ministry of Agriculture, Food and Rural Affairs has agreed to assume the co-ordination role for the C.P.S. (Canada Plan Service). This will require an on-going effort to maintain the existing CPS data resources and support the development of new plans and technical leaflets. The farm construction industry requires technical information on several topics; chimney design for natural ventilation, diaphragm bracing for post frame construction, the use of laminated posts, and information regarding tunnel ventilation for combating animal heat stress. The industry has identified building construction/inspection as an area that needs improvement. In particular, building inspection across the province is not uniform and courses should be mandatory for building officials to assure their education level.

Service is required:

1. To support OMAFRA's ef fort to maintain the existing CPS data resources and promote the development of new plans and technical leaflets.
2. To develop a design leaflet for chimney design for naturally ventilated livestock buildings.
3. To write a Factsheet regarding tunnel ventilation for livestock and poultry.
4. To write a Factsheet regarding wind forces on farm buildings.

To ensure that trainir.g/upgrading courses are available for building officials and building contractors so that uniformity of building construction/inspection takes place.

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6. STRUCTURAL ISSUES AS A RESULT OF THE 1998 EASTERN ONTARIO ICE-STORM

The January 1998 Ice Storm caused numerous farm building failures in Eastern Ontario. The ice build up on the roofs and additional snow caused loading that approached or exceeded the design loading for the area. The fact that one building failed while another survived with similar or greater loading was evident on many farms. Many factors could be involved that would explain this phenomena. The age of the building could indicate the extent of structural deterioration or might reflect changes in building codes. The manufacturer or type of truss construction could be a factor. Additions to structures and modifications may have led to some failures. Investigation of the failures which occurred during this period may give some indication of what factors were involved. A second stage of investigation could identify buildings that were structurally damaged, did not fail. These may need remedial work before being heavily loaded again. The identification of deterioration in existing buildings and recommendations for remedial actions would be a definite benefit of this investigation. The information gathered in these investigations would then be made available to the agricultural communities through seminars and workshops held at various locations.

Serivce is needed:

to assess the safety of structures in the affected area.

Investigate the deterioration of connectors, joints, etc. as influenced by the ice storm loading

Evaluation of ice/snow effects on tarp covered arch frame structures (Biotech type)

Measure effects of loading on plates, beams, etc. (deflections, etc.)

Establish wind effect on snow or ice accumulation

Review/revise current Canada Plan Service designs, prepare leaflets and bulletins as needed.

Carry out an evaluation of snow/ice removal methods from farm building roofs (steam, de-icers, mechanical).

Publish information, organize information meetings, communicate findings to building officials, contractors, building material suppliers and consulting engineers that serve the Eastern Ontario region.

PROPOSED SUB-COMMITTEE MEMBERSHIP FOR 2000
LIVESTOCK ENGINEERING SUB-COMMITTEE

Organization	Name	Contact Information	Term End
OMAFRA	John Johnson (Chair)	OMAFRA, 667 Exeter Rd. LONDON, ON N6E 1L3 Ph. 519-873-4096 Fax 519-873-4062	Passed due
OMAFRA	(Secretary)		2003
Univ. of Guelph	Dr. Jan Jofriet	University of Guelph, School of Engineering, GUELPH, ON NIG 2WI Ph. 519-824-4120 Ext. 3642 Fax 519-836-0227	2001
Private Sector	Jim Cooke	R.R.#1 Walkerton, ON N0G 2V0 Ph. 519-881-1188 Fax 519-881-3628	2000
Private Sector	Fred Groenestege	Fred Groenestege Const. Ltd. R.R.#1, SEBRINGVILLE, ON N0K 1X0 Ph. 519-393-6579 Fax 519-393-6532	2000
OMAFRA	Dr. Neil Anderson	Manager, Health Management OMAFRA 2nd Floor, Wellington Place, R.R.#1 FERGUS, ON N1M 2W3 519-846-0965 Fax 519-846-8101	2001
Shur-Gain Agresearch	Bob Robson	R.R.#3, Burford, ON N0E 1A0 Ph. 519-424-2550 Fax 519-424-2570	2002
Private Sector	One of: David Waud (Sun North), Murray Gould or Paul Fallis (BSM Agri. Ltd.)		2003
Private Sector	One of: Ray Jacobs, (Landmark Builders) or Ron MacDonald (Agviro Inc.)		2003

FOOD ENGINEERING SUBCOMMITTEE

REPORT TO

ONTARIO AGRICULTURAL AND FOOD

ENGINEERING RESEARCH AND SERVICES

COMMITTEE

December, 1999.

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LIST OF ACRONYMS

AAFC	Agriculture and Agri-Food Canada
ARIO	Agriculture Research Institute of Ontario
CARC	Canadian Agricultural Research Council
CCC	Canada Committee on Crops
CCF	Canada Committee on Food
FRDC	Food Research and Development Centre
GDP	Gross Domestic Product
GFTC	Guelph Food Technology Centre
HACCP	Hazard Analysis and Critical Control Points
MISA	Municipal-Industrial Strategy for Abatement
MMO	Materials and Manufacturing Ontario
NRC	National Research Council Canada
OAFERSC	Ontario Agriculture and Food Engineering Research and Services Committee
OASCC	Ontario Agricultural Services Coordinating Committee
OFPRF	Ontario Food Processing Research Fund
OFRSC	Ontario Food Processing Research and Services Committee
OMAFRA	Ontario Ministry of Agriculture, Food and Rural Affairs
SOE	School of Engineering
TQM	Total Quality Management
UOG	University of Guelph

1.0 EXECUTIVE SUMMARY

The Food Engineering Subcommittee presents this report to the Ontario Agriculture and Food Engineering Research and Services Committee (OAFERSC). The need to be competitive in the World marketplace remains the number one challenge facing the food manufacturing sector in Ontario. In reviewing the actions that would benefit Ontario food processors, the Food Engineering Subcommittee has decided to place the highest priority on the following recommendations.

RESEARCH PRIORITIES

1. Improved technologies for pasteurization such as non-thermal processes to reduce processing cost and to enhance nutritional and flavour quality, and shelf life.

2. Baking and frying processes modelling to improve baked and fried products' quality.

3. Image processing for inexpensive in-line methods for detection of glass pieces in glass containers, chicken bones in mechanically deboned chicken and sclerotia (black fungus) in beans.

4. Development of efficient methods for separation, purification and concentration of neutraceuticals from various sources (soybean, tomato, hemp, etc.) to be used in supplements and in fortified foods.

5. In-line sensors for microbial detection, moisture at high temperature for baked foods and dough properties.

6. Raw material characterization for food product quality.

7. Optimizing material handling in wine industry.

2.0 INTRODUCTION

This is 1999 report of the Food Engineering Subcommittee to OAFERSC. Food engineering is a specialized discipline within the engineering profession and food engineering research and service are necessary supports to the Ontario food processing industry. In addition to reviewing these areas within the Food Engineering Subcommittee, food engineers serve on other committees and subcommittees within the OASCC committee structure. The Food Engineering Subcommittee recognises the importance of maintaining closer interactions with the Ontario Food Research and Services Committee (OFRSC) as well as the Expert committees on Food Engineering and Refrigeration at the national level.

The Food Engineering Subcommittee has representatives from producers' boards, private sector, OMAFRA, University of Guelph, Agri. & Agri.-Food Canada and the National Research Council (NRC).

3.0 MISSION or MANDATE

Concerns itself with the research and services regarding technology, processes and equipment related to the production side of the food processing. This is in contrast to the Food Science concerns which are food product related. There is of course, a great deal of interdependent, interaction between these engineering and science disciplines.

4.0 INDUSTRY/SECTOR SCAN

4.1 Major accomplishments since last report

(a) Mr. Hugh W. Fraser (OMAFRA) worked on a CanAdapt project "Controlled ripening and reduced ethylene effects in horticultural crops using novel ethylene antagonists". Highlights are: (i) Ethylene speeds up senescence of many horticultural crops with a resulting decrease in shelf life. (ii) Ethylene improves quality of bananas and tomatoes by promoting faster more uniform ripening before distribution. (iii) Ethylene is produced whenever organic materials are stressed, oxidized, or combusted. (iv) Ethylene causes premature yellowing of produce such as spinach, broccoli, parsley, cucumbers, and causes damage to most floral commodities. To date, the horticultural industry has already made changes based on his findings. Subtle changes in management could save the industry millions of dollar annually.

(b) Mr. Hugh W. Fraser (OMAFRA) also worked on a CanAdapt project "Time/temperature in head lettuce handling". There may be some potential for using *Visual Non-Reversible Time-Temperature Indicator Technology*, but only as an internal quality control check on handling procedures, not for pointing blame for temperature control problems throughout the system.

(c) Edible coating/film to produce low fat fried foods by Dr. G.S. Mittal's group (UOG): Fat absortion in fried foods was reduced by 90% using selective edible coating/film. Extensive modelling work was done to get optimum transport properties of the film/coating for minimum fat transfer and optimum water migration for better crust formation in low-fat fried foods. In another study, a soy protein film coating was developed and evaluated to reduce fat transfer in deep fried foods during frying. Soy protein isolate solutions (10% SPI) with 0.05% gellan gum as plasticizer cooled after being held at 80°C for 20 min provided suitable films. There was a significant fat reduction (55.12%±6.03%db) between fried uncoated and coated discs of doughnut mix. The same films were used on potato fries. Some panellists observed a slight difference between the coated and uncoated fries but many preferred the coated fries over the uncoated ones. Penetration test on potato fries showed no significant difference between the texture of coated (SPI with gellan gum) and the uncoated fried samples. A solution of 10% SPI with 0.05% gellan gum is recommended for coating foods to reduce fat intake during deep-fat frying.

(d) Food pasteurization using electric pulses by Dr. G.S. Mittal's group (UOG): A unique process that uses pulsed electrical field to preserve liquid and semi-liquid foods has been developed. Many break-throughs at Guelph made this process suitable for commercialization, and placed us at the forefront worldwide in this area. The University has filed for a US patent on "pulsed electric field pasteurization" in August 1998.

(e) Neural network for process design by Dr. G.S. Mittal's group (UOG): A neural network was successfully developed to design complex thermal processing of packaged foods for safety and quality. Other neural networks developed for food process design are: (i) freezing process design for different shaped foods, (ii) psychrometric predictor for air properties, (iii) predicting heat and mass transfer during smokehouse cooking of frankfurters, and (iv) temperature, fat and moisture changes during deep-fat frying of slab shaped food products coated with edible coatings.

(f) Dr. V. Davidson's (SOE) research is related with computer-based process control and decision-support in food processing. Research supported by the OMAFRA Foods program ("Software and Sensors for improved control of food processing") extended the fuzzy inferencing techniques to automated inspection of food products. Funding for this research was also obtained from Materials and Manufacturing Ontario (MMO), and supported by Dipix Technologies Inc. (Ottawa-based manufacturer of Qualivision™ systems) and Nabisco Brands Inc. (Peek Frean Bakery, East York).

Publications and Presentations

Papers in refereed Journals

Mittal, G.S. and Zhang, J. 1999. Vibration responses of wheat doughs. Int. J. Food Properties 2(3):243-253.

Williams, R. and Mittal, G.S. 1999. Low-fat fried foods with edible coatings -- modeling and simulation. J. Food Sci. 64:317-322.

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Ju, J. and Mittal, G.S. 1999. Effects of fat-substitutes, fat levels and cooking methods on the quality of beef patties. J. Food Processing and Preservation 23:87-107.

Mittal, G.S. 1999. Mass diffusivity of food products. Food Review Int. 15(1):19-66.

Kajuna, S.T.A.R., Mittal, G.S. and Bilanski, W.K. 1998. Mechanical properties of plantains by vibrational method. Int. J. Food Properties 1(3):207-220.

Conference Proceedings/Presentations

Mittal, G.S. and Zhang, J. 1999. Vibrational characteristics of Cheddar and Mozzarella cheeses at various fat and moisture contents for in-line process monitoring and control. Paper No. 99-3024, Amer. Soc. Agric. Engg., St. Joseph, MI.

Mittal, G.S. and Zhang, J. 1999. Artificial neural network development for predicting freezing time of various shapes foods. Paper No. 99-3132, Amer. Soc. Agric. Engg., St. Joseph, MI.

Mittal, G.S. 1998. Liquid food pasteurization using low energy electrical pulses. Int. Agric. Engg. Conf., AIT, Bangkok, Thailand.

Factsheets (available from OMAFRA in English and French)

Fraser, H.W. and Chaput, J. 1999. Long-term storage of carrots #98-073, p6, OMAFRA.

4.2 Current state of the industry

Down-sizing and consolidation of Canadian and U.S. operations continue to impact the structure

of many Ontario food processing companies. Due to regional and global trade agreements, the food industry in Ontario is facing **international competition**. This will require considerable readjustment, productivity improvement and enhancement in product quality and safety. There is a large emphasis on value-added aspect of food processing. Downsizing putting less emphasis on R & D and more on organization aspects. Resources in Engineering R & D are decreasing due to overhead cuts and profit oriented approach. Food engineers are leaving to other industries and consulting due to less job satisfaction.

Less competition is being created due to merging as the number of owners are decreasing in each food sector. On the other hand, **Co-packing** is increasing where smaller food processors are processing foods for larger processors. This is creating number of smaller processors and lower wages jobs. Many small companies are producing specialized food products. Ethnic group food companies are also emerging to supply special food items to various communities.

Education and training of workforce to properly use modern technology is lacking in food industry compared to other industries such as automobile industry. Due to the use of newer technology a wide gap is created between technology and training of workers.

Nutritional issues are important for the industry. **Nutraceuticals** are also being produced in Ontario, but progress is slow. Overall, Canada is behind USA in this respect. In fortification of food products, juices in particular, USA is leading due to advantages in regulations. Chemical analysis of nutraceuticals are needed as well as improved labelling regulations are required.

Economic problems: For export, Canadian processed food is more attractive due to low value of Canadian dollar. However, imported equipment, machinery and raw material are more costly.

Energy managements are needed by process and equipment modifications to reduce processing cost.

4.3 Emerging issues

Safety and Quality: Air quality in the plants is required to be maintained particularly where ovens are used. Water quality for food processing is also becoming more critical. Effective use of water and reuse of waste water are needed. Sensors for quality attributes and food safety are needed to effectively produce products with consistently high quality and greater consumer acceptance. For this, rapid and in-line methods for food analysis and quality control are required.

Technological Challenge: Computer-dependant technologies continue to be important within the industry. Advances in instrumentation, automation and software, vision systems, and wider implementation of HACCP related quality control systems are all leading to wider use of computer technology. Vision scan and x-ray devices are needed for bruise detection on fresh produce, proper baking of cookies, and detection of worms and blood spots in food products.

Neutraceutical Processing: There seems to be interest in extracting neutraceuticals from soybean, tomato, hemp, etc. Appropriate separation technology is needed to extract active ingredients. Cold processing is required to avoid degradation of active ingredients. Research is also needed in purification and concentration of neutraceuticals.

Wine Industry: Due to the growth of wine industry in Ontario, there are research needs in process engineering area.

Byproduct Utilization: Presently byproducts from many food industries are going for animal feeding. Research is needed to utilize the byproducts from corn, apple and grape processing industry.

5.0 REPORT OF ACTION TAKEN ON PREVIOUS YEAR'S RECOMMENDATIONS

ARIO Response to Food Engineering Recommendations

ARIO recognizes the research priorities contained in the recommendations presented by the Food Engineering subcommittee. Work to address these priorities is supported in the Food and other programs that are part of the Enhanced Partnership with the University of Guelph. Research into food processing has also been supported through the Special Research and other competitive research programs. These research priorities will also be taken into consideration during the review of the Food program next year.

The limited human and financial resources available dictate that all priorities can not be addressed simultaneously. In order to address new issues or expand work in existing priorities research in existing areas must be either scaled back or completed to make the resources available. OASCC committees can assist in this process by identifying research areas which are no longer high priority.

A mechanism is being put in place to redirect resources within the Enhanced Partnership Agreement to high priority areas which are not being adequately addressed. Committees will need to identify which areas are the highest priority and also which areas can be scaled back.

The move of Agriculture and Agri-Food Canada researchers from Ottawa to Guelph will provide further opportunities for increased collaboration between the University of Guelph and federal researchers allowing more efficient use of resources.

Sub-Committee Response:

This year there was no response for each priority, but only general comments were given. The Food Engineering sub-committee was not happy as in the last 4 years, not much work was supported in the recommended areas. It is frustrating that after spending considerable time by the sub-committee members in developing these priority no action was taken.

In previous years the recommendations of this sub-committee were grouped under various areas. Due to this, OMAFRA might have ignored the projects listed under the different areas. This year sub-committee is providing recommendations project-wise so that none of the recommendations are ignored.

Not much work has been done on many past recommendations. Therefore some projects are being recommended again.

Since food industry is the second largest industrial sector in Ontario, and food industry is facing many engineering related problems, more resources are needed for food engineering research.

6.0 STRATEGIC DIRECTIONS/PROBLEMS OR ISSUES/SECTOR PRIORITY

1. Advanced and novel food processes for better productivity, quality and safety of food

One of the process identified is the non-thermal pasteurization of liquid foods using pulsed electrical field. The work is being conducted for the last few years at the School of Engineering, University of Guelph. Several hurdles have been removed. However more work is needed to make this process commercially viable.

Three processes identified are deep-fat frying, pan-frying and baking. Some work on deep-fat frying is in progress at the School of Engineering. Work is needed in the areas of pan-frying of meat patties for *E.coli* safety, and on baking for better product quality.

2. Sensors, image processing and automation for higher productivity, safety and quality

In-line sensors for the detection of contaminants and quality parameters in foods are needed for consumer safety and product quality. Three processes were identified for image processing: inexpensive in-line methods for detection of glass pieces in glass containers, small chicken bones in mechanically deboned chicken and sclerotia (black fungus) in beans. No work is in progress on these areas.

Three in-line sensors were identified: for microbial detection, moisture at high temperature for baked foods and dough properties. Some work is in progress on microbial sensor in the University of Guelph, but no work is being carried out on other sensors.

3. Neutraceutical processing – separation, purification and concentration

Work is needed on the development of efficient methods for separation, purification and concentration of neutraceuticals from various sources (soybean, tomato, hemp, etc.) to be used in supplements and in fortified foods. Some work is in progress in the University of Guelph, and AAFC laboratory in Guelph. However more work is needed.

4. Characterization of raw ingredients for quality control in processed foods

No work is in progress in Ontario on this or related topic.

5. Wine industry growth in Ontario requires optimum material handling

Applied research is needed in this area for expanding Ontario wine industry. No work is in progress at present.

7.0 RECOMMENDATIONS ARISING FROM THE GAPS/BARRIERS/DEFICIENCIES

Ontario Agricultural and Food Engineering Research and Services Committee
Food Engineering Subcommittee

Recommendation #1

Issue: Advanced and novel food processes for better productivity, quality and safety of food

OASCC linkage: Food processing committee.

Target agencies: Recommendation to ARIO and OMAFRA.

Title: Improved technologies for pasteurization such as non-thermal processes to reduce processing cost and to enhance nutritional and flavour quality, and shelf life.

Details:

The new and improved non-thermal pasteurization processes should increase product quality and process efficiency. Novel technologies are needed to safely extend shelf life without perceptibly altering the natural flavour, composition and taste of foods. The new technologies should maintain product quality standards and integrity, minimize energy utilization, and maximize yields.

The beverage industry has an immediate need for replacing thermal pasteurization as consumers are interested in minimal processed and fresh-like fruit juices. The conventional process is not only energy intensive but denature the products' colour, flavour and vitamin content. There is great need for a non-thermal pasteurization that is safe, energy efficient, economical and does not affect nutrition and flavour. Wine manufacturers are also interested in non-thermal pasteurized grape juice for better flavour of wines.

Background:

The food manufacturing industry is facing increasing global competition, government regulations and consumer demands. These challenges require adoption of new technologies and methodologies to create and sustain a competitive advantage in the market place.

Even a small improvements in manufacturing technology through technological innovation, efficiency improvements or resource utilization would have a large economical effect on food industry given its size. A 1% improvement in productivity by improved and novel technologies will save $50 million per year.

The recommendation should be addressed by research institutions and universities, food industry, and collaborative research between industry and academic researchers. There is some current research activities at the School of Engineering, University of Guelph in this area.

Ontario Agricultural and Food Engineering Research and Services Committee
Food Engineering Subcommittee

Recommendation #2

Issue: Advanced and novel food processes for better productivity, quality and safety of food

OASCC linkage: Food processing committee.

Target agencies: Recommendation to ARIO, AAFC and OMAFRA.

Title: Baking and frying processes modelling to improve baked and fried products' quality.

Details:

Modern cooking systems are becoming complex due to industry's expanding need for higher production, short cooking time, consistency and better quality, higher yield, energy efficiency and versatility. The models will provide a better understanding of the process mechanisms, assist with better design of equipment and process, and will promote the more efficient use of existing equipment. A detailed understanding of the fat transfer profile is of major interest to processors as consumers are more aware about the amount of fat they consume. Optimization of the process parameters will result in better process control, product quality, and lower fat. Pan-frying process required to be studied with respect to the changing physical properties and chemical composition of beef patties during cooking and consequent microbial destruction.

Heat, moisture and fat transfer within the food and crust formation occur during cooking including deep-fat frying, broiling, baking, pan frying. Cooking is still considered more of an art than a science. For cooking to be adequately controlled, designed and optimized, the food quality kinetics during cooking must be understood. Fried foods constitute a large percentage of the snack food industry. Research on frying has generally concentrated on the kinetics of oil degradation. Little is known about the fat transfer during frying as affected by edible coatings of frozen products. Recent consumer trend toward healthier foods is creating significant pressure to reduce fat in cooked products. Fried foods still contain large amount of fat, in some cases >45%. Excess fat consumption is considered as the key dietary contributor to coronary heart disease and cancer of breast, colon and prostate.

Background:

As the market for fully cooked products continues to expand, modelling and simulation that predict product temperature, cooking yield, and pathogen lethality during cooking will be valuable tools for designing effective and safe thermal processes. With the increasing concern on safety and quality of beef and chicken patties, the importance of prediction of heat and fat transfer, microbial lethality and optimization of pan-frying is evident. The development of in-line sensors and process modelling and optimization will be critical in implementing total quality management (TQM) and HACCP in the food industry. The food industry represents about $5 billion of Ontario's GDP. A 1% improvement in productivity through improved process control represents $50 million.

Collaborative research on these needs is required between researchers from research institutions and universities and food industry.

Ontario Agricultural and Food Engineering Research and Services Committee
Food Engineering Subcommittee

Recommendation #3

Issue: Sensors, image processing and automation for higher productivity, safety and quality

OASCC linkage: Food processing committee.

Target agencies: Recommendation to ARIO, AAFC and OMAFRA.

Title: Image processing for inexpensive in-line methods for detection of glass pieces in glass containers, chicken bones in mechanically deboned chicken and sclerotia (black fungus) in beans.

Details:
Baby foods and fruit juices are generally filled in glass containers due to consumer preference. During filling of foods or juices in glass containers at high speed, occasionally, a few glass containers are shattered due to impact. Consequently, a few pieces of broken glass with variant sizes may find their way into the containers during this shattering process. To detect containers that contain glass pieces, a scanning system is needed. For this system to be of practical value it has to be cost effective and fast enough so as to cope with the speed of the filling process. Currently, there are a few systems in the market. These systems are based on x-ray technology. Unfortunately, the speed and high cost of such systems are among the major factors that hinder their use in these applications. Since popularity of ground chicken products are increasing, the demand for deboned chicken is also increasing. Detection of small chicken bones in deboned meat is difficult. An in-line detection system is needed so that these small pieces of bones can be separated. Similarly sclerotia due to black fungus in white-beans reduces the quality of the product. Image processing based method seems to be suitable for the separation of sclerotia.

Background:
The development of in-line image processing detection devices for above-mentioned problems will be critical for food safety and quality, and in implementing total quality management (TQM) and HACCP in the food industry. The food industry represents about $5 billion of Ontario's GDP. A 1% improvement in productivity through improved process control represents $50 million.

Collaborative research on these needs is required between researchers from research institutions and universities and food industry.

Ontario Agricultural and Food Engineering Research and Services Committee
Food Engineering Subcommittee

Recommendation #4

Issue: Neutraceutical processing -- separation, purification and concentration

OASCC linkage: Food processing committee.

Target agencies: Recommendation to ARIO, AAFC and OMAFRA.

Title: Development of efficient methods for separation, purification and concentration of neutraceuticals from various sources (soybean, tomato, hemp, etc.) to be used in supplements and in fortified foods.

Details:
The separation, purification and concentration of neutraceuticals and functional foods are critical for their quality and functionality. Neutraceuticals and functional foods will be used in supplements and in fortified foods. Suitable process is needed for isolating isoflavones from soybeans. A significant body of work is required to understand the properties of neutraceuticals and to develop process technologies that ensure the functionality of these ingredients remains intact. This is an area of high interest to many in the food business.

Background:
The neutraceutical market is increasing day by day. If Canadian food industry will not develop the products containing neutraceuticals, then consumers will get the foods fortified with neutraceuticals from USA or other countries.

This recommendation should be addressed by the industry, research institutions and academic researchers.

Ontario Agricultural and Food Engineering Research and Services Committee
Food Engineering Subcommittee

Recommendation #5

Issue: Sensors, image processing and automation for higher productivity, safety and quality

OASCC linkage: Food processing committee.

Target agencies: Recommendation to ARIO, AAFC, CCF and OMAFRA.

Title: In-line sensors for microbial detection, moisture at high temperature for baked foods and dough properties

Details:
Due to complex nature of food and its processing, in-line sensing of food quality and microorganisms is needed. Inexpensive and reliable sensors and methods are needed for these. Process controls need measurement of key process parameters to determine the current operating conditions. In-line sensors for monitoring many food quality and safety parameters are not available.

Control of optimized processes is presently limited not by lack of computer or control devices, but by lack of sensors to measure specific food properties. Development of suitable sensors is needed for control systems to measure the critical process parameters and assist in their control. The lack of sensors and control systems for food processes is a major impediment to development of a fully automated food processing system.

Artificial neural network (ANN) is a useful tool for real-time prediction of data and for online process control.

Background:
The development of in-line sensors, ANN and process modelling and optimization will be critical in implementing total quality management (TQM) and HACCP in the food industry. The food industry represents about $5 billion of Ontario'sGDP. A 1% improvement in productivity through improved process control represents $50 million.

Collaborative research on these needs is required between researchers from research institutions and universities and food industry.

Ontario Agricultural and Food Engineering Research and Services Committee
Food Engineering Subcommittee

Recommendation #6

Issue: Characterization of raw ingredients for food quality control in processed foods

OASCC linkage: Food processing committee.

Target agencies: Recommendation to ARIO, AAFC, CCF and OMAFRA.

Title: Raw material characterization for product quality.

Details:
There is quite a large variability in raw food material (cereals) from year to year and batch to batch. These variabilities are affecting functionality of the ingredients particularly for cereal industry manufacturing breakfast cereals, breads, cookies, etc. This research will minimize undesirable changes due to processing, and will improve productivity. The present lack of sufficient data on physical properties of basic food ingredients and products has limited the application of many well established engineering principles.

Background:
The quantification and modelling of food properties and processes will be critical in improving the productivity in food industry. Based on the improvement in the productivity by this research of 0.5%, the net saving to the food industry will be $25 million per year.

This recommendation should be addressed by the industry, research institutions and academic researchers.

Ontario Agricultural and Food Engineering Research and Services Committee
Food Engineering Subcommittee

Recommendation #7

Issue: Wine industry growth in Ontario requires optimum material handling

OASCC linkage: Food processing committee.

Target agencies: Recommendation to ARIO, AAFC, FCC and OMAFRA.

Title: Optimizing material handling in wine industry.

Details:

Due to the rapid growth of wine industry in Ontario in recent years, there is a need to improve its productivity. One of the area suggested is the optimization of material handling so that process efficiency can be improved, byproducts can be minimized and utilized, and processing wastage can be minimized.

Background:

The optimization of material handling will be critical in improving the productivity in wine industry. Applied research is needed in this direction so that the wine industry can use the information without doing in-house research or trial approach.

Some research is also needed to minimize and utilize processing waste from the wine industry.

This recommendation should be addressed by the industry, research institutions and academic researchers. It is difficult to estimate the economical impact on the wine industry.

8. SUMMARY OF DISTRIBUTION OF RECOMMENDATIONS

	To Agencies					
Recommendation	AAFC	ARIO	CCF	CARC	OMAFRA	Other
1. Improved technologies for pasteurization such as non-thermal processes to reduce processing cost and to enhance nutritional and flavour quality, and shelf life		X			X	
2. Baking and frying processes modelling to improve baked and fried products' quality	X	X			X	
3. Image processing for inexpensive in-lin thods for detection of glass pieces in glass containers, chicken bones in mechanically deboned chicken and sclerotia (black fungus) in beans	X	X			X	
4. Development of efficient methods for separation, purification and concentration of neutraceuticals from various sources (soybean, tomato, hemp, etc.)	X	X			X	
5. In-line sensors for microbial detection, moisture at high temperature for baked foods and dough properties	X	X	X		X	
6. Raw material characterization for food product quality	X	X	X		X	
7. Optimizing material handling in wine industry	X	X	X		X	

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RURAL ENVIRONMENT ENGINEERING SUBCOMMITTEE

Report

TO

ONTARIO AGRICULTURAL AND FOOD ENGINEERING RESEARCH AND SERVICES COMMITTEE

December 3, 1999

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LIST OF ACRONYMS

AAFC	Agriculture and Agri-Food Canada
ARIO	Agricultural Research Institute of Ontario
CARC	Canadian Agri-Food Research Council
CC	Canada Committees
CPS	Canada Plan Service
CURB	Clean Up Rural Beaches
EFP	Environmental Farm Plan
LICO	Land Improvement Contractors of Ontario
MCCR	Ministry of Consumer & Commercial Relations
MNR	Ministry of Natural Resources
MOE	Ministry of Environment
OAFERSC	Ontario Agricultural and Food Engineering Research and Services Committee
OFEC	Ontario Farm Environmental Coalition
OMAFRA	Ontario Ministry of Agriculture, Food, and Rural Affairs
UG-AC	University of Guelph Alfred College
UG-RC	University of Guelph Ridgetown College
SPOF	Strategic Plan for Ontario's Fisheries
SWEEP	Soil and Water Environmental Enhancement Program
UTRCA	Upper Thames River Conservation Authority

1.0 EXECUTIVE SUMMARY

The Rural Environment Engineering Subcommittee presents this minor report to the Ontario Agriculture and Food Engineering Research and Services Committee (OAFERSC). The committee recognizes the new procedures to be followed and also that this year the Food Program is the major area of review. Issues related to Food Program are to be forwarded to the appropriate committee for consideration.. The Rural Environment Engineering Subcommittee primarily focused on last years report and evaluated whether there were any new more pressing issues to address before the next major review and what the progress has been made on the research recommendations from the previous year.

Air and water quality (more specifically groundwater quality) and water quantity are the major issues to be addressed within the rural environment area. Increased pressure from the public and other government agencies is pushing the agricultural sector to continue to increase activity in the air and water quality areas from a research and technology transfer standpoint.

The following emerging needs were identified in 1998 and are still appropriate to 1999:

1) Municipal Bylaws to Control Development of Large Livestock Operations

2) Community Resentment Towards the Establishment of Large Swine Operations

3) Continued Rise in Public Scrutiny and Interest in Non-traditional Components of Water Pollution.

4) Municipal Waste Water Treatment Systems At Capacity and Looking at Less Costly Alternatives - Phosphorous Offset Methods.

5) Draught Conditions in Western Ontario is Stimulating Discussions on Water Rights and Allocation.

6) Drainage Looked at as Contributor to Low Flow Rates in Streams.

Methane - Greenhouse Gas from manure

(added for 1999)

Vegetable Wash Water Quality and Legislative Impacts

Livestock Access to Streams and Conflict with Fisheries Act

Irrigation Water Quality and Food Safety

Nutrient Management Plan Bylaw Court Challenge

Impacts of weather to runoff and infiltration..

In past reports, the top two research and top two non-research recommendations were reported. This year, the top six research priorities are only reported to match the Environmental program review at the University of Guelph in 1999. The priority recommendations for research and services as identified by the Subcommittee are as follows:

1) **Investigate methods to reduce livestock manure odours. (R & D)**

This project involves an examination of various manure treatment options with the specific goal of reducing odour levels at the barn and storage. It is especially aimed at liquid swine manure systems, though the suitability for other livestock types should also be considered. Treatment could occur during collection, during transfer to storage, during storage, or some combination. The feasibility of biofilters,m echanical systems, aeration, bacterial and enzyme methods etc. need to be investigated. There are two phases of odour generation to investigate i) from the barn and ii) from the storage.

2) **To evaluate and quantify the impact of large livestock operations on the rural environment.(R & D)**

A comprehensive study is required to evaluate and quantify the impact on the environment by large livestock operations. Items that must be studied are:
odours from the buildings

- odours from the manure storage
- odours from spreading large volumes of manure
- impact of manure transport on public roads
- ability to handle large quantities of manure and the time required
- volumes of water used and possible impacts on ground water supplies
- effects of concentration of livestock facilities in an area versus spot development
- do MDS formulas adequately assess odour potential of large livestock units

3) **To develop improved systems for applying manure to the land more accurately, cost effectively, and with fewer odours. (R & D)**

Research should be oriented towards developing techniques to accurately apply manure both solid and liquid in a cost effective manner. Nutrient management plans are requiring low rates of application and equipment is not available to accomplish the task.

4) **To identify sources of water contamination in agricultural watersheds and put into perspective the various contributors. (R & D)**

A comprehensive study is needed to examine all sources of water contamination in agricultural watersheds and put into perspective the relative contributions of the various sources. This should focus on surface water quality but could be applied to groundwater as well. Key indicators would include: suspended sediment, nitrate-N, BOD, E. Coli bacteria, total P, Cryptosporidium, giardia, and others.
Practices to consider would include:

a) farm practices such as: tillage, nutrient management, manure storage and spreading, livestock pasturing, crop rotation; and

non-farm practices such as road construction and maintenance, rural septics ystem use, municipal sewage treatment plant scheduled and unscheduled releases, other spills, wildlife, etc.

5) To develop a standardized test for manure odour-reducing additives.(R & D)

This project involves an examination of what evaluation procedures are in place and develop a standardized test procedure to evaluate the effectiveness of these additives. Testing must be "realistic". First level testing may be in small vessels in lab for initial screening process but must also include field scale testing in larger tanks outside where manure is added on a continuing basis through variable seasonal conditions.

6) Testing and adapting urban wastewater treatment technologies for their applicability to the agro-industry.

A systematic research and development work for the adaptation of treatment processes found in urban and industrial centre to rural areas is necessary as the agrifood industry is under pressure to meet increasingly stringent environmental standards.

2.0 INTRDUCTION

This is the 1999 minor report of the Rural Environment Engineering Subcommittee to the Ontario Agriculture and Food Engineering Research and Services Committee (OAFERSC). This report highlights emerging needs and research recommendations in the rural environment area. As well, the services (non-research) recommendations were reviewed.

The committee's focus was on research and extension needs related to the rural environment (soil, water, and air). Issues were addressed from an engineering perspective recognizing that there will be some grey areas which may generate some similar recommendations from other committees especially with the present day pressures and interest related to large livestock operations. These crossover areas should not be looked upon as duplication, but rather as important issues recognized and pursued by two disciplines in a co-operative effort.

Information in this report was provided by subcommittee members representing Colleges of Agricultural Technology, University of Guelph, Agriculture and Agri-Food Canada, OMAFRA, and the private sector.

3.0 SUBCOMMITTEE ACTIVITIES

A meeting of the subcommittee members was held on November 25, 1999 at the Ontario Ministry of Agriculture, Food, and Rural Affairs building in Guelph. The previous years report was reviewed and updated. The University of Guelph Environmental program was reviewed last year making this years efforts primarily focused on reviewing the previous years recommendations and verifying that they were still appropriate to the needs of the time. Consensus was that the recommendations were still appropriate. Food Safety is the primary focus for this year in alignment with the U of G program reviews.

The revised structure of OASCC and duties were outlined to the committee. Membership content

and possible options to get a greater private sector content were discussed.

The views and consensus of the committee is reflected in this report. The majority of committee members were present.

4.0 STATE OF THE INDUSTRY

Soil, water, and air issues related to large livestock operations continue to dominate the agricultural industry. The primary stimulation is the construction of swine barns. The number of large swine and dairy operations are still on the increase . More and more municipalities are passing bylaws to try and control construction in an orderly fashion. Nutrient management plans, days of manure storage, and MDS II requirements are included in most bylaws. Variations occur when attempts are made to inventory land used for application of manure and guarantee application rates. Local resident organizations are still very vocal and well organized in presenting their concerns and demands. Municipalities are reacting accordingly.

Much attention is still focused on nitrates as the primary contaminant but bacteria is getting more and more attention. Runoff from agricultural lands is being scrutinized from many fronts. Department of Fisheries and Oceans and Environment Canada are now getting involved more directly with situations that may be impacting fisheries in Ontario ie. two incidents in Eastern Ontario where charges have been laid.Demands to protect and create riparian zones along waterways and wetlands is also still on the rise.

Phosphorous loading on streams is still a primary concern in many areas of the province. Many municipal treatment systems are dependent on rivers to assimilate treated waste water from cities and towns. Assimilative capacities of some rivers have reached or are reaching the maximum levels permitted . Municipalities are searching for cost effective alternatives such as "phosphorous trading" or "phosphorous credit" type accounting systems based on improvements to agricultural land and nutrient management techniques. Waterloo region has successfully implemented a financial incentive program in targeted areas to encourage implementation of BMP's in agricultural areas. Wellington County is in the process of initiating a similar program bases on the Waterloo model. Other areas (Lake Simcoe, South Nations etc.) are in the process of also initiating similar programs. The problem still remains as to how to account for water quality improvements (phosphorous) which are hard to measure or take time to appear. Empirical and modelling methods are being developed for the purpose of accounting water quality gains.

The Environmental Farm Plan process went through its sixth full year of operation and distributed close to 2500 workbooks which is consistent with previous years. Funding for the next two years has been attained and will be in place. The target for the coming year is again to process 2000 workbooks. The incentive program which provides $1500 towards improvements identified in the Farm Plan is being well used and on the increase. The Rural Water Quality Program in Waterloo implemented a completed Environmental Farm Plan as a requirement of eligibility for the program as has the Wellington County program.

Activity in the tile drainage industry increased again in the 1998/1999 season. From a survey conducted of manufacturers of agricultural tile, approximately 152 million feet of tile was sold for agricultural purposes in 1998. This is the highest quantity sold in the 1990's. From 1990 to 1995, the annual quantity of tile sold ranged from 53 to 89 million feet. This increased in 1996 to 107 million feet and rose again in 1997 to 139 million. There were $8.6 million in loans issued to

landowners through the Tile Loan Program 1998/99. This is a decrease from the $9.3 million issued in the 1997/98 fiscal year.

In 1998, there were 114 drainage businesses, 455 operators, and 189 machines licensed in the province under the *Agricultural Tile Drainage Installation Act*. Drainage tubing prices remain stabile and are not expected to change much. There was a substantial demand for training of contractors in order to obtain operator licenses (100% increase).

The amount of small diameter tile installed is unknown but is estimated to be well over a million feet. Most of which is self installed by land owner using mini-tilers. It is estimated that there are well over 160 mini-tiler machines in Ontario. To date, there is only one machine licensed for commercial use under the *Agricultural Tile Drainage Installation Act*.

In the 1998/99 fiscal year, the total expenditures by the municipal governments authorized by the *Drainage Act* was $24.9 million (8% increase from previous year). New reports from engineers represented 340 projects with a total cost of $17.9 million (8% increase from previous year). A total of 1678 drain maintenance projects were reported on with a total cost of $4.5 million. The municipal drainage superintendent costs totalled $2.48 million. This combined total of $6.98 million is a 7% increase from the previous year).

The Department of Fisheries and Oceans, in consultation with stakeholders, has developed a Class Authorization system for the maintenance and repair of existing municipal drains. They, in partnership with local Conservation Authorities, have funded the collection of data to catalogue the fish habitat that currently exists in municipal drains. This information is used to classify each municipal drain into six different categories. As a result, municipal drainage superintendents will be able to receive a "class authorization" for their proposed work, provided they follow the predefined conditions for that drain. This positive development promises to minimize the frequent conflicts between municipalities and environmental agencies in the maintenance and repair of existing municipal drains.

The province has recently announced a review of their drainage programs. This review will be initiated in early 2000 with results announced later in that year.

5.0 ACHIEVEMENTS

.1 Publications, Factsheets, Manuals

Private Water Well Omners – Dealing With Water Shortages, Factsheet, Jim Myslik, OMAFRA

Hazardous Gases, Factsheet, Luc Brunet, OMAFRA

How To Prepare For Irrigation During Water Shortages, Factsheet, Jim Myslik, OMAFRA

Best Management Practices – Integrated Pest Management ***Blue Ribbon Award Winner CSAE ****

Milking Centre Washwater Disposal Manual, Bob Stone, OMAFRA

Oil and Gas Exploration, Production and Legislation On Ontario Farms, Petroleum Resources Centre, MNR and OMAFRA.

.2 Educational Courses

Primary Drainage Contractors Course, Feb. 2 - Feb.11, 1999

Advanced Drainage Contractors Course, Feb. 22- March 4, 1999

Municipal Officials Drainage Course - Apr. 1999

Concrete Manure Storage Design Course, 1999

Custom Manure Application Course, 1999

Pollution Control Course, 1999

Drainage Superintendents Course, 1999

Nutrient Management Sessions - 1999 (several)

Ontario Environmental Farm Plan - 1999 All Ontario.

.3 Reports, Periodicals, Articles

Interim Report - 1998 - By : Claude Weil, Doug Joy, and Chris Kinsley. Establishment of Centres for On-site Wastewater Treatment

Final Report - 1998 - Sarah Hurd, Anna Crolla and Claude Weil. Ferme Vachalê Constructed Wetland

Dignard Artificial Wetland - 1998 - Olivier Fankhauser and Claude Weil. Year 3 of Operation, 1997-year end report

Cost-Benefit Analysis for a Constructed Wetland in Eastern Ontario, Canada, by : Pierre-Alain Blais and Claude Weil, Annual Northeast Agricultural and Biological Engineering Conference (NABEC, 1998).

Article in Agri-food Research in Ontario
Spring 1998 Vol.21 no.1 - Reducing water and Energy use in the first step to Expanding production in poultry abattoirs.

.4 Other

Ontario Rural Wastewater Centre, University of Guelph School of Engineering and Alfred College.

6.0 EMERGING NEEDS

.1 Municipal Bylaws to Control Development of Large Livestock Operations

Large livestock operations are still on the rise in Ontario. Municipalities are reacting to the concerns of the public at large as well as reacting to bylaws instituted in neighbouring municipalities with the view that if neighbouring bylaws are more restrictive swine barn will move to those areas with less control. Municipalities have been given more responsibilities and power. Some are making full use of it. OFEC released a position paper on bylaw development which has helped to reduce the variability between municipalities but with limited success too date. Bylaws are replacing moratoriums on construction. Nutrient management plans are required in all the new bylaws along with MDS II and minimum storage requirements.

Other variables that are being introduced are inventory of land used for manure spreading, verification of application rate, minimum acreage owned, registration of land to be used for manure application etc. Municipalities are searching for mechanisms to give them more control over the situation.

.2 Community Resentment Towards the Establishment of Large Swine Operations

Resentment towards the construction of large swine producing facilities continue to escalate. Guarantees of no odours, no ground water contamination, and no surface water contamination are being demanded. Rural residents who may not even be adjacent to or near the construction sites get actively involved. Some situations are evenv proceeding through the courts to challenge the construction and operation of larger swine barns.

.3 Continued Rise in Public Scrutiny and Interest in Non-traditional Components of Water Pollution.

Water quantity and quality issues are stimulating people to become more aware of other types of water pollution such as Cryptosporidium, giardia, residual medicines and hormones etc.. As their knowledge base increases so does their suspicions of what else might be out there that could be harmful and/or persistent. In many cases there is a link to agriculture.

Housing is on the increase once again across much of the province and is putting increased demands on sewage treatment plants and the assimilative capabilities of receiving waters. Technology is not available or affordable to reduce phosphorous levels further necessitating a search for other methods to deal with the situation.

Phosphorous is the key component. If Phosphorous levels in the river can be reduced ie. BMP practices by agriculture, present waste treatment technology can still be used (less costly). Another approach that is being looked at is look at the possibility of increasing river flow. Is their waste in the use of water or is too much water being used upstream ie. Irrigation. These are both major issues for the farm community to face and the pressures will increase as more municipalities face waste treatment expansion and upgrades. Presently, there are four watersheds actively involved in this

approach and many more will are forthcoming.

.5 Draught Conditions in Western Ontario is Stimulating Discussions on Water Rights and Allocation.

The general public is used to an abundance of clean surface and ground water. As these supplies get taxed as they have been this summer, sudden attention is given to how the water is used and who has first rights to it. In some areas, this has been the second year and there were conflicts related to supply and use. A Drought Task Force has been initiated by the Province to address the situation and draft a plan that can be used in year 2000 should the low waters levels continue.

.6 Drainage Looked at as Contributor to Low Flow Rates in Streams.

In the past, drainage has been accused of increasing peak flows in channels. Now it is being looked as a contributor to low flows in dry periods. Focus is on base flow reductions and reduced ground water recharge.

.7 Methane - Greenhouse Gas from manure.

As more and more manure is spread on the land, methane is emitted into the atmosphere which threatens the ozone layer. As people look for more reasons why livestock agriculture should not expand, greenhouse affect could be the next front to deal with. Research is already started in Ottawa.

(new additions)

.8 Vegetable Wash Water Quality and Legislation

Concerns have been raised regarding fruit and vegetable wash water and how it is handled. Applying the legislation as it is in place could have serious economic impacts.

.9 Livestock Access to Streams and Conflict with Fisheries Act

The private sector are searching for new mechanisms to meet their expectations of stream water quality. Complaints have been lodged under the Fisheries Act which is federal jurisdiction and charges have been laid. This is an indication that the public is not satisfied with provincial response to complaints of this nature. Under the Fisheries Act it is much easier to verify a charge.

1.0 Irrigation Water Quality and Food Safety

Irrigation water quality and food safety is an issue of the future. Limited situations have been encountered in Ontario ie. apple cider contamination. It is a rising issue in the US and is likely to be more important here in Ontario especially with fresh produce and quality of irrigation water that is used.

.1 Nutrient Management Bylaw and Plan Court Challenge

Even though nutrient management planning and bylaws are still in their infancy stages in terms of development, the public is not trusting and in their desire for greater environmental security have challenged the nutrient management approach in the courts. Interest is high from both sides of the issue and could greatly influence the future depending on the ruling.

.2 Impacts of weather to runoff and infiltration.

!999 was another dry year in approximately six locations in the province. Agriculture, urban water supplies, sewage treatment facilities, private water supplies, recreation, power generation, ecological systems were all affected. Reserves are very low. Problems and conflicts are probable for the coming year unless there is an unexpected turn around in the weather patterns. In some areas, it is projected that it will take 3 to 5 years of normal precipitation to get back to normal. Long term impacts have not yet been determined.

7.0 REPORT OF ACTION TAKEN ON PREVIOUS YEAR'S RECOMMENDATIONS

ARIO Response to Agricultural Engineering Recommendations

ARIO recognizes the research priorities which have been identified in the recommendations presented by the Agricultural Engineering Research and Services committee and its subcommittees.

Rural and Crop Engineering

Priority areas such as manure management, site specific farming, emissions, and water management can be addressed through the Agri-Food System Resources and Environment program at the University of Guelph. In addition, research is also supported in plants and animal programs.

In April, the University of Guelph presented the new Agri-Food System Resources and Environment program to ARIO. This research program will cover from 1999-2003 and combines the resources and mandates of the former Agri-Food Systems and Environment and Natural Resources research program. The new program will allow for research into the biophysical, economic and social implications of resource management issues confronting the agri-food sector in Ontario. Research will focus on the management of biophysical and socio-economic resources to ensure a competitive agri-food sector while enhancing and preserving the environment.

The Agri-Food System Resources and Environment program has been developed and refined over the past two years through a series of consultations which included OASCC committees, OMAFRA, AAFC and faculty at the University of Guelph.

The program utilizes an issues based structure similar to that of the Environment and Natural Resources program which it replaces. It has been structured around 6 objectives corresponding to a biophysical or socio-economic resource and goals which outline a long term requirement for research (greater than 4 years). The objectives and goals will be re-evaluated every 4 years as part of the program review.

In order to address these objectives and goals, a set of research issues have been identified which will contribute to the long term requirements. The issues listed are in response to the identified needs for urgent information put forward by the OASCC committees including the Agricultural Engineering committee. Research conducted on these issues will be expected to contribute to the overall objectives and goals of the program. Each issue has short term (4 years) desired outcomes listed.

The program proposal as presented to ARIO addresses research priorities brought forward by the sub-committees. Project selection for the new program is currently underway. Once the projects have been finalized a document summarizing deliverables for each issue will be distributed.

A copy of the program proposal has been attached for your information. Details of the program

can be obtained from the program director, Dr. Michael Goss. The program proposal is also available from the University's website at:

http://www.uoguelph.ca/research/omafra/documents/afsre.pdf

The limited financial and human resources available dictate that not all priorities can be addressed simultaneously. In order for new priorities to be addressed, or emphasis shifted, existing research must be scaled back or completed so that the resources can be reallocated.

A mechanism is being put in place to redirect resources within the Enhanced Partnership Agreement to high priority areas which are not currently being adequately addressed. Committees will need to identify areas which are the highest priority and also which areas of research can be reduced.

Service recommendations do not fall within the mandate of ARIO. The service recommendations included in this year's report which were addressed to ARIO have been forwarded to the Agriculture and Rural Division of OMAFRA for response.

Summary of Agricultural Engineering Committee Recommendations.

RURAL ENVIRONMENT ENGINEERING SUBCOMMITTEE

Research # III.1.1-B

Investigate methods to treat livestock manure to reduce odours.

Response:

AAFC

Several studies are in progress in the US, Europe and Canada on effective odour control, in animal production operations. Some of the Canadian studies are under the HEMS program. A key input requirement is economic feasibility of proposed odour control methods. Not all studies appear to include economic assessment of the proposed technology. The US Pork Council commissioned a study (in ca. 1995) of published information on odour control from animal operations. An international conference on control of ammonia and odour was held in the Netherlands in 1997. It is understood that the American Society of Agricultural Engineers will have a meeting in 2000 relating to this topic. In investigating methods relating to odour control, it is necessary to be cognizant that while odour is controlled, the problem is not shifted from pollution of air by odour to other environmental areas, e.g. release of ammonia into the air (by aeration), increased nitrate loading on soil from treated manure, increased greenhouse gas release (nitrous oxide). A proper balance is required to ensure least impact on the total environment. Details of this recommendation are related to appropriate research centres for consideration vis-a-vis their research programs.

Research # III.1.2-A

To develop improved systems for applying manure to the land more accurately, cost effectively, and with fewer odours.

Response:

AAFC

GPCRC - No activity

SCPFRC - Resources

SCPFRC has recently initiated a 3-year project in partnership with Ontario Pork, the Agricultural Adaptation Council, and Nuhn industries to investigate swine manure storage and application methods which conserve nutrients, protect the environment from chemical or biological contaminants, and benefit crop yield through suppression of soil-borne diseases. A precision "Manure research Unit" liquid manure applicator has been built by Nuhn industries and will be used to investigate manure application methods on site-specific crop yield.

ECORC -

Research # III.1.3-A

To evaluate and quantify the impact of large livestock operations on the rural environment.

Response:

AAFC

In connection with the proposal, it is noteworthy that a similar study was reported on at the HEMS meeting in Toronto in April 1998. The information is in the HEMS Proceedings. Another study on community acceptance of large livestock operations is in progress in Manitoba, with the involvement of Manitoba Agriculture. A conference on siting of large livestock operations (Canadian Agri-Food Research Council) was held in Ottawa several years ago and Proceedings are available. The Brandon Research Centre (R.G. Eilers and K. Buckley) and the Prairie Farm Rehabilitation Administration (in Regina) is involved in a prairie-wide joint (co-managed) project entitled "A methodology to evaluate land suitability for the application of hog manure". There was a paper presented at the 42nd Annual Manitoba Society of Soil Science Meeting, February 2-3, 1999. This latter study does not deal directly with odours, but there may be some indirect effects. It may be useful to assess the findings and recommendations of these studies vis-a-vis the proposed comprehensive study. Details of this recommendation are related to appropriate research centres for consideration vis-a-vis their research programs.

MOE

This recommended research priority is relevant to environmental protection issues and is timely to deal with pressures from the development of large livestock operations in Ontario. Especially, proper guidelines or consistent rules need to be developed so that the location and management of facilities can be based on key relevant issues.

The proposed items for the study do not include possible impacts on surface waters in conjunction with possible impacts on groundwater supplies and their volumes. It is recommended that this be taken into consideration.

Recommended under high priority. This comprehensive study should be completed in conjunction with the Nutrient management plans and relevant findings. There are other research priorities listed such as III-1.4-B and recommendation 1-3 (Issue: Manure Management from the Soil, Water and Air Research and Services committee) that have some relationship to this research priority. Some explict priority to priority study ties or working framework need to be established. Consider the need to assess impacts on groundwater supplies.

Research # III.1.4-B

To identify sources of water contamination in agricultural watersheds and put into perspective the various contributors.

Response:

AAFC

GPCRC - Effects of fertilization and crop rotation on soil quality, crop productivity, greenhouse gas (CO_2 and N_20) emissions and water quality are being investigated. Plots established in 1959 which allow for baseline nitrate and P leaching studies are being used in a cooperative study with University of Guelph for the nitrate modeling component.

SCPFRC - The possible movement and endocrine-disrupting effects on fish of estrogenic hormones from fields receiving manure is being evaluated on two swine farms and one dairy farm.

ECORC - No activity

MOE

This is a critical priority for the big picture. It is typically addressed through partnership efforts based on watershed management approaches dealing with strategic issues of environmental protection and conservation and resource management. Considerable evolution of approaches and knowledge in this field has been accomplished in watersheds such as Grand River, Lake Simcoe and Bay of Quinte. However, not all issues are generic to all areas. They are also site or area specific. In some Ontario watersheds these approaches have recently evolved to comprehensive point and non-point source assessments and recommendations for management programs. As noted in the proposal, past initiatives dealt mostly with some of the issues.

We have concern that only nitrate-N was indicated for nutrients; other nitrogen forms or even phosphorous were left out.

This is high priority research. Perhaps it needs better defined focus and specific "big picture" setting advancing our knowledge in some of the noted watershed initiatives underway or potentially including additional work on the Maitland Ecosystem Health Project.

Consider research into the enhancement of agricultural drains for improved wildlife and aquatic habitat. Why put clean water into drains if there is no habitat for wildlife or fish? The comprehensive study should also look into the practice of tile field drainage with respect to both water quality and quantity impacts. In addition, consider the impacts of farm practices in the use of biosolids (sewage and paper mill) - this links with a later issue - biosolids/waste application and treatment (from OSWASRC). Further consider the need for a comprehensive study to examine all sources of contamination. Fertilizer and pesticide runoff into surface and groundwater should be incorporated into this study based on normal agricultural and non-agricultural use practices and not just as a result of spills.

Research # III.1.5-A

To assess and establish agriculture's baseline needs for drainage, water supply, nutrient use in order to find an equitable balance with other uses of the rural environment such as fisheries, wildlife, and natural habitat.

Response:
AAFC

GPCRC - ***Several studies are currently underway to determine and improve nutrient management requirements for field crops. Examples include effects of tillage systems and cover crops on soil quality, crop productivity and greenhouse gas emission; effects of fall and spring tillage systems on soil quality and crop productivity, short and long-term effects of no-till, conventional till and ridge till on crop productivity and nutrient demands; effects of compost source on soil quality and crop productivity; effect of fertilization and crop rotation on crop productivity and; development of new N mineralization soil tests for Ontario to improve nutrient management***

SCPFRC - *No activity.*

ECORC - *No activity*

Research # III.1.6-A

To evaluate the application of natural channel design systems to municipal drains in agricultural Ontario and to investigate inexpensive methods of adapting natural channel design techniques to existing municipal drains.

Response:

AAFC

GPCRC - No activity in this area
SCPFRC - No activity.
ECORC - No activity

Research # III.1.7-A

To assess non-conventional forms of water management with the focus on ground and surface water treatment systems.

Response:

AAFC

GPCRC - Effects of controlled drainage and controlled drainage/subirrigation and N rate on corn and soybean production and water quality (herbicides and nitrates) is being evaluated in specific plot work and on two demonstration farms on coarse and fine soils. This controlled drainage system is an effective way to reduce nutrient and herbicide contamination.

SCPFRC - No activity.

ECORC - No activity

Research # III.1.8-A

Effectiveness of engineering related management practices for the protection of water quality.

Response:

AAFC

GPCRC - The hydraulic and aeration characteristics of soil under native forest, no-tillage and clay loam soils is being studied to determine the extent to which annual cropping has degraded these properties and to obtain information on how these characteristics might be improved in annually cropped soils.

SCPFRC - No activity.

ECORC - The pore system and aeration properties of soil under best and worst management systems are being studied to determine how the timing of field operations affects soil properties and ultimately crop yields.

Research # III.1.9-A

Manure application for conservation tillage systems.

Response:

AAFC

GPCRC - A new study was initiated this year in cooperation with private industry and the

University of Guelph to determine impacts, ideal rate of application, interaction with crop nutrient cycling, decomposition rates and effect on soil quality of various composts including livestock manure. Parameters measured will include crop yield, soil fertility, soil organic matter, soil physical quality, water storage and water transmission parameters, crop root growth and soil structure.

SCPFRC - Optimum application rates and timing of sidedressing liquid swine manure on field crop production is being evaluated on a site-specific basis.

ECORC - No activity

8.0 SUMMARY OF DISTRIBUTION OF RECOMMENDATIONS
To Agency(ies)

RECOMMENDATION	AAFC	ARIO	CC	CARC	OMAFRA	OTHER
Priority I (R&D) Investigate methods to reduce livestock manure odours (p. 18)	x	x	x 3			
Priority II (R&D) To evaluate and quantify the impact of large livestock operations on the rural environment. (p. 20)	x	x	x 3			MOEE
Priority III (R&D) To develop improved systems for applying manure to the land more accurately, cost effectively, and with fewer odours. (p. 22)	x	x	x 1			
Priority IV (R&D) To identify sources of water contamination in agricultural watersheds and put into perspective the various contributors. (p. 23)	x	x	x 1			MOEE
Priority V (R&D) To develop a standardized test for manure odour-reducing additives. (p. 25)	x	x	x 3			
Priority VI (R&D) Testing and adapting urban wastewater treatment technologies for their applicability to the agro-industry. (p. 26)	x	x	x 1			MOEE

Canada Committees: 1 - Natural Resources 2 - Crops 3 - Animals 4 - Food

9.0 DETAILED RECOMMENDATIONS

RURAL ENVIRONMENT ENGINEERING SUBCOMMITTEE

RECOMMENDATION TO

AGRICULTURE & AGRI-FOOD CANADA-EASTERN REGION, AGRICULTURAL RESEARCH INSTITUTE OF ONTARIO, AND CANADA COMMITTEE ON ANIMALS

RESEARCH PRIORITY # I **(1.1 B)**

Investigate methods to reduce livestock manure odours.
(R & D)

DETAILS:

This project involves an examination of various manure treatment options with the specific goal of reducing odour levels at the barn and storage. It is especially aimed at liquid swine manure systems, though the suitability for other livestock types should also be considered. Treatment could occur during collection, during transfer to storage, during storage, or some combination. The feasibility of biofilters, mechanical systems, aeration, bacterial and enzyme methods etc. need to be investigated. There are two phases of odour generation to investigate i) from the barn and ii) from the storage.

BACKGROUND:

Livestock manure, like any other biological material, undergoes a breakdown of organic matter by microorganisms. When this happens in anaerobic conditions, such as with traditional liquid manure systems, it results in odours. Proper separation distances to conflicting land uses, good housekeeping practices, and covers on storages are examples of methods farmers have used to reduce odour impacts. These approaches are not enough to satisfy the present day rural population. Manure treatment research has been going on for many years but the focus has not always been odour control - other factors have included: reducing volume, concentrating or changing the form of nutrients, producing methane, etc.
Research is needed to examine methods of odour control practical for use on today's farms, especially targeted at large swine farms with liquid manure.

Composting of liquid manure is one technology that is being investigated and should continue. Others include methane digestion, use of additives, mechanical aeration, separation in combination with a further treatment step, dehydration, and others.

COST/BENEFIT:

This research will be of greatest benefit to large operations using liquid manure, especially swine. The viability of the industry hinges on being able to expand and build these specialized units. Better solutions are required than bylaw control which will greatly hinder the competitiveness of the industry.

RESOURCES:

This project needs the cooperation of researchers in waste management, odour control, and economics, as well as livestock specialists, agricultural systems specialists, and livestock farmers. Lab and Farm-scale projects will be needed.

RURAL ENVIRONMENT ENGINEERING SUBCOMMITTEE

RECOMMENDATION TO

AGRICULTURE & AGRI-FOOD CANADA - EASTERN REGION, AGRICULTURAL RESEARCH INSTITUTE OF ONTARIO, CANADA COMMITTEE ON ANIMALS AND MOEE

RESEARCH PRIORITY # II **(1.2 A)**

To evaluate and quantify the impact of large livestock operations on the rural environment. (R & D)

DETAILS:

A comprehensive study is required to evaluate and quantify the impact on the environment by large livestock operations. Items that must be studied are:

- odours from the buildings
- odours from the manure storage
- odours from spreading large volumes of manure
- impact of manure transport on public roads
- ability to handle large quantities of manure and the time required
- volumes of water used and possible impacts on ground water supplies
- effects of concentration of livestock facilities in an area versus spot development

do MDS formulas adequately assess odour potential of large livestock units

-

BACKGROUND:

Increased competitiveness in the global marketplace has encouraged the development of very large, highly efficient livestock facilities. One facility can replace 10-20 old "farmsteads" in both animal numbers and corresponding feed requirements and manure production. Communities and involved government agencies are struggling with developing means to encourage the investment and job placements associated with these facilities while ensuring that environmental issues are adequately addressed.

Concerned neighbouring residents request information and assurances but neither are available. Ontario's experience with impacts of large operations is limited. Large swine operations are the primary target of late. This trend is likely to spread to other livestock types in the future.

Also, the water needs of these large operations are such that there may be an impact on neighbouring water user's supplies. Answers should be obtained before water supplies are stressed or depleted.

COST/BENEFIT:

Proper guidelines and possibly rules need to be developed so that communities can feel confident that environmental issues are properly addressed. Ideally, the guidelines or rules should be similar across all communities so that location of facilities can be based on other issues rather than individual community environmental acceptance. Decisions if made now would be based on subjective rather than objective information.

RESOURCES:

This project spans many fields of expertise from waste management specialists to hydrogeologist to rural community advisors.

RURAL ENVIRONMENT ENGINEERING SUBCOMMITTEE

RECOMMENDATION TO

AGRICULTURE & AGRI-FOOD CANADA, AGRICULTURAL RESEARCH

INSTITUTE OF ONTARIO, AND CANADA COMMITTEE ON

NATURAL RESOURCES

RESEARCH PRIORITY # III **(1.3 A)**

To develop improved systems for applying manure to the land more accurately, cost effectively, and with fewer odours. (R & D)

DETAILS:

Research should be oriented towards developing techniques to accurately apply manure both solid and liquid in a cost effective manner. Nutrient management plans are requiring low rates of application and equipment is not available to accomplish the task.

BACKGROUND:

Farmers are under much more pressure to complete nutrient management plans but if they need to apply manure at low rates (less than 4000 gal/ac.), equipment is not available to accomplish this task with the accuracy needed.
Some work has been done in this area recently but it was aimed at accurate application of only liquid manure and it involves dropping manure on the surface. There is also a need to address odour reduction and reduction in nutrient losses during spreading through equipment design changes.

COST/BENEFIT:

Society will gain through better management and nutrient application control. The farmers will gain by being able to implement nutrient management plans and save on fertility costs.

RESOURCES:

Waste management specialists would be required for the field scale evaluation and design of manure application systems. An agricultural economist should be consulted to determine what economic gains could be achieved.

RURAL ENVIRONMENT ENGINEERING SUBCOMMITTEE

RECOMMENDATION TO

AGRICULTURE & AGRI-FOOD CANADA-EASTERN REGION, AGRICULTURAL RESEARCH INSTITUTE OF ONTARIO, CANADA COMMITTEE ON NATURAL RESOURCES, and MOEE

RESEARCH PRIORITY # IV **(1.4 B)**

To identify sources of water contamination in agricultural watersheds and put into perspective the various contributors. (R & D)

DETAILS:

A comprehensive study is needed to examine all sources of water contamination in agricultural watersheds and put into perspective the relative contributions of the various sources. This should focus on surface water quality but could be applied to groundwater as well. Key indicators would include: suspended sediment, nitrate-N, BOD, E. Coli bacteria, total P, Cryptosporidium, giardia, and others. Practices to consider would include:

a) farm practices such as: tillage, nutrient management, manure storage and spreading, livestock pasturing, crop rotation; and

b) non-farm practices such as road construction and maintenance, rural septic system use, municipal sewage treatment plant scheduled and unscheduled releases, other spills, wildlife, etc.

BACKGROUND:

Research effort in the past has been directed at individual farm practises (such as manure spreading) and examining water quality impacts, then recommending changes in farm practices to reduce the potential for water quality impairment. A considerable amount is known about the water quality impacts of many of these individual farm practices. What is not well understood is the big picture - what the relative contributions are of many activities in a watershed to the overall water quality of the watershed.

In these times of limited financial resources to solve environmental problems we need to be able to target the practices that are having the greatest impact. For example, if the sediment loading in a watershed is unacceptable and if the greatest loadings are caused by poor practices of ditch construction and repair, we should not direct all our efforts toward further reducing soil erosion. Similarly, if the bacteria loadings are found to be split between animal and human sources, we should direct more effort (compared to current levels) into identifying the pathways and preventing the human contributions.

Ultimately, the most useful result of this research would be a comprehensive computer program that would consider many factors and could be used to model loadings and identify most likely sources

of contamination and most cost effective education/prevention efforts. Models are in the process of being developed or adopted to the situation and the effort should be further supported.

COST/BENEFIT:

As individual farms grow in size, it is likely that more and more of the blame for reduced water quality will be directed to farmers, whether warranted or not. Municipal controls will become stricter, especially on livestock farming. Being able to avoid some of the speculation on contamination sources and address the real problems may help avoid laws based on more emotion than fact. This could have a profound impact on whether a farm operation can even establish or expand in a given municipality.

RURAL ENVIRONMENT ENGINEERING SUBCOMMITTEE

RECOMMENDATION TO

AGRICULTURE & AGRI-FOOD CANADA-EASTERN REGION, AGRICULTURAL RESEARCH INSTITUTE OF ONTARIO, AND CANADA COMMITTEE ON ANIMALS

RESEARCH PRIORITY # V **(1.5 A)**

To develop a standardized test for manure odour-reducing additives.(R & D)

DETAILS:

This project involves an examination of what evaluation procedures are in place and develop a standardized test procedure to evaluate the effectiveness of these additives. Testing must be "realistic". First level testing may be in small vessels in lab for initial screening process but must also include field scale testing in larger tanks outside where manure is added on a continuing basis through variable seasonal conditions.

BACKGROUND:

Many additives are now on the market-some are enzymes, some are masking agents, some change the pH, some are bacterial in nature, some may be feed additives, and affect digestion, etc. Some work has been initiated in the US by Bundy, some in Montreal by Suzelle Barrington, and some is currently underway by the Prairie Swine Centre. Odours are still identified as the main reason for the resistance to large livestock operations. There is a need to advance the techniques and coordinate the test procedures with other researchers so all products are evaluated in a similar manner. Testimonials are not acceptable.

COST/BENEFIT:

This research will be of to all livestock operations but especially to large the swine operations using liquid manure. In some cases, whether these farms can effectively control odours may determine their ability to expand or establish a new facility in an area as bylaws become more and more restrictive.

RESOURCES:

This project needs the cooperation of researchers in waste management, odour control, and economics, as well as livestock specialists, agricultural systems specialists, and livestock farmers. Farm-scale projects will be needed though lab-scale projects may be appropriate for initial evaluation of manure additives.

RURAL ENVIRONMENT ENGINEERING SUBCOMMITTEE

RECOMMENDATION TO

AGRICULTURE & AGRI-FOOD CANADA-EASTERN REGION, AGRICULTURAL RESEARCH INSTITUTE OF ONTARIO, CANADA COMMITTEE ON NATURAL RESOURCES, and MOEE

RESEARCH PRIORITY # VI **(1.6 B)**

Testing and adapting urban wastewater treatment technologies for their applicability to the agro-industry.

DETAILS:

A systematic research and development work for the adaptation of treatment processes found in urban and industrial centre to rural areas is necessary as the agrifood industry is under pressure to meet increasingly stringent environmental standards.

BACKGROUND:

Applying liquid waste on agricultural land is, for many rural industries such as canneries, the best option in rural areas, but it is often not possible because of lack of land or odour problems as well as climatic considerations. There is now a growing pressure for the rural industries to rely on technologies found more often in urban industrial areas such as activated sludge systems and trickling filters.

Because there often exist some land for irrigation, if not enough, near these rural industries certain steps of wastewater treatment processes found in urban areas, such as nutrients removal and chlorination, may be omitted at a great saving to the agro-industry. This must be the subject of studies based on an in-depth knowledge of biological, chemical and physical treatment processes.

10.0 APPENDIX

.1 Terms of Reference

1. To review research work and service programs being carried out in Ontario and elsewhere.

2. To disclose problems that face the agricultural industry and which require investigation.

3. To assess and suggest priorities for new research, development, service and information transfer programs and recommend which programs presently under way should be continued, expanded or terminated.

4. To make recommendations on:

a) planning and conducting co-operative research, development, service and information transfer projects, and

b) dividing and allocating research projects in order to provide co-ordination and to avoid unnecessary duplication between stations.

5. To estimate, where possible, costs involved in the conduct of new programs and to supply cost/benefit information.

6. To recommend, where possible, how monies might be obtained or freed to expand current programs or conduct new programs.

7. To supply a written report, at least annually, to the Agriculture and Food Engineering Research and Services Committee.

8. To participate in the planning and execution of meetings: to share research, development, service and information progress and to determine problem areas that need to be addressed.

Rural Environment Engineering Subcommittee Membership 1998

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.3 Inventory of Person Years

.4 Coding System

A four part code is used to identify each of the projects outlined herein.

The first part, the roman numeral, identifies the subsection of agricultural engineering to which the project belongs. These subsections are:

I	Energy, Power and Processing
II	Power and Machinery
III	Rural Environment
IV	Structures and Environment

The second part identifies the priority of research:

1.	Very Important
2.	Important
3.	Desirable

The third is a coding number. It indicates a listing order but not necessarily the project's priority within the group.

The fourth is a letter to indicate the level of research in that topic:

A	- New topic, no known research.
B	- Expansion needed, some research under way.
C	- Continue at existing level.
D.	- Research complete, reallocate efforts to A or B.

LIST OF RURAL ENVIRONMENT RESEARCH AND SERVICES NEEDS Pre-1998

VERY IMPORTANT

III 1.1 A. RESEARCH

Investigate methods to treat livestock manure to reduce odours.

This project involves an examination of various manure treatment options with the specific goal of reducing odour levels. It is especially aimed at liquid swine manure systems, though the suitability for other livestock types should also be considered. Treatment could occur during collection, during transfer to storage, during storage, or some combination. Odour levels should be compared: in the barn, near the storage, during agitation prior to spreading, and during and after spreading on the land (if that is the method of manure use).

III 1.2 B. RESEARCH

To research, evaluate, and develop alternative methods of handling and disposal of large volumes of swine and dairy liquid manure. (R & D)

Research should be oriented towards promising technologies (solid-liquid separation, constructed wetlands, composting, adsorption). Finally, systems that address the issue of the treatment of brown water (seepage from the manure pile) are required on dairy farms handling solid manure.

Methods need to be developed to reduce the cost and/or land base required to deal with the large volumes of manure produced and stored by the oncoming large intensive livestock productions in a cost effective and environmentally sustainable manner.

III 1.3 A. RESEARCH

To evaluate and quantify the impact of large livestock operations on the rural environment.

A comprehensive study is required to evaluate and quantify the impact on the environment by large livestock operations. Items that must be studied are:

- odours from the buildings
- odours from the manure storage
- odours from spreading large volumes of manure
- impact of manure transport on public roads
- ability to handle large quantities of manure and the time required
- suitability of methods of spreading manure (odour and water impacts)
- effects of concentration of livestock facilities in an area versus spot development
- do MDS formulas adequately assess large livestock units
- potential impact on ground water supplies

III 1.4 B. RESEARCH

To identify sources of water contamination in agricultural watersheds and put into perspective the various contributors.

A comprehensive study is needed to examine all sources of water contamination in agricultural watersheds and put into perspective the relative contributions of the various sources. This should focus on surface water quality. Key indicators would include: suspended sediment, nitrate-N, BOD, E. Coli bacteria, total P, and others. Practices to consider would include:

a) farm practices such as: tillage, nutrient management, manure storage and spreading, livestock pasturing, crop rotation; and

b) non-farm practices such as road construction and maintenance, rural septic system use, municipal sewage treatment plant scheduled and unscheduled releases, other spills, wildlife, etc.

III 1.5 B. SERVICE

Rural household alternative waste treatment systems Factsheet.

To develop a factsheet outlining the various alternative household waste treatment systems that are available now or could be in the near future. (Non R & D)

III 1.6 A. SERVICE

SYMPOSIUM ON LARGE LIVESTOCK OPERATIONS AND THE RURAL ENVIRONMENT

To convene a symposium to address the topic of large livestock operations and the rural environment.

III 1.7 A. RESEARCH

To assess and establish agriculture's baseline needs for drainage, water supply, nutrient use in order to find an equitable balance with other uses of the rural environment such as fisheries, wildlife, and natural habitat.

Research is required to determine the base line needs of agriculture in Ontario to be competitive in world markets and then to determine how far it can go in addressing the issue of environmental sustainability. The research should deal with these specific topics:

III 1.8 C. SERVICE

To develop a nutrient management extension program for Ontario farmers.

A nutrient management extension program should be developed and delivered to farmers throughout Ontario. The program should stress the importance of nutrient management on farms from the perspective of yield, timing of nutrient applications, crediting use of manure and other organic materials and minimizing risk of damage to the environment.

Farmers should be encouraged to soil test and analyze manure as a basis for developing a good nutrient management program. Aids such as a computer program and nutrient management worksheets are available to assist the farmer in doing this plan.

III 1.9 A. SERVICE

TILE WATER SAMPLING PROTOCOLS AND ANALYSIS

To develop a tile water sampling protocol and analysis interpretation information package.

III 1.10 A. SERVICE

CENTRE TO STORE, CATALOGUE, MARKET AND DISSEMINATE RESEARCH DATA

To develop a system whereby data collected from research projects funded for or related to agriculture can be stored in a standardized useable format, catalogued for easy retrieval, evaluated for quality and to establish a central storage facility for this information to be stored, marketed and disseminated.

III 1.11 C. RESEARCH

To evaluate the application of natural channel design systems to municipal drains in agricultural Ontario and to investigate inexpensive methods of adapting natural channel design techniques to existing municipal drains.

The research should deal with these specific topics:

i) A literature review on natural channel design techniques with a critique on it's application to municipal drains in Ontario.
ii) Investigate adaptations of natural channel design techniques that could be applied to existing municipal drains to optimize the benefits while minimizing costs.
iii) Apply the design adaptations determined in 2) to an existing municipal drain site. Measure the success of the adaptation by monitoring drainage capacity, water quality, diversity of biota, etc.

III 1.12 C. SERVICE

Farm Fuel Storage Information Package and Extension Program

To develop a farm fuel storage information package and establish an extension program for farmers

and fuel suppliers on proper fuel storage and fuel handling techniques as required by the recently updated (1993) Gasoline Handling Act and the Gasoline Handling Code.

III 1.13 C. RESEARCH

To assess non-conventional forms of water management with the focus on ground and surface water treatment systems.

Research is required to investigate, develop, and evaluate ground and surface water treatment systems that could be used to reduce the amount of contaminants reaching water sources. Techniques which promote the immobilization, destruction, or transformation of contaminants such as organic fertilizers, barnyard runoff, chemical fertilizers, milkhouse washwater etc. must be tested at the fields and the watershed. These techniques should include artificial marshes or wetlands, water quality basins, infiltration ponds, and various vegetative infiltration systems.

III 1.14 C. RESEARCH

Effectiveness of Engineering Related Management Practices for the Protection of Water Quality

Additional research is needed to verify the effectiveness of existing and proposed structures and management practices intended to control the quality of water leaving areas of agricultural production. The research should focus on establishing the pathways that carry potential contaminants away from sites where the contaminants are being controlled or treated, fluxes along these pathways, and the processes that control the concentrations and amounts of substances that reach receiving waters.

The research should focus on the identification of important processes through field studies, the quantification of process parameters through a combination of field and laboratory studies, and the development and refinement of computer models for simulating the processes. Special attention should be given to examination of hydrologic processes that apply in periods during and immediately after snowmelt.

The required research should deal with these topics:

- The role of preferential flow through macro-pores in conveying chemicals and bacteria to buried-pipe drains.

- The partitioning of nitrate between drainage from buried pipes and percolation to deeper groundwater under tile-drained fields.

III 1.15 C. RESEARCH/EVALUATION

Manure Application for Conservation Tillage Systems

Further research and on-farm evaluation is required to study the effects of manure application in combination with soil conservation tillage methods. With conservation tillage practices, a different soil structure results having a different moisture retention capacity. It is important to know the sensitivity of the groundwater movement as affected by the conservation tillage techniques to have some indication of pollution potential. Alternative methods of manure application on conserving soil systems should be investigated.

IMPORTANT

III 2.1 C. RESEARCH

Assessment of Water Quality Improvement Due to Outlet Controlled Watertable Management

Research is needed into additional methods of watertable management that are alternatives or additions to the normal drainage function of subsurface buried-pipe drains. The alternatives or additions include the construction of control structures to maintain submerged conditions at drain outlets for subirrigation during dry periods or controlled drainage for water quality improvement (e.g., denitrification) and flowrate regulation.

Research is needed to examine these alternatives separately and in combination to see how successful they are in meeting the anticipated design objectives, what combinations of alternatives are compatible, what difficulties any of these alternatives create for the achievement of traditional goals of soil drainage, and how the alternatives compare in economy and durability with existing standard methods (if any exist).

The kind of research required includes field measurements of the performance of trial installations. The data collected should include soil water amounts as they vary with time, quantity and quality of outflow water and the change in quality during passage through the system, variation of watertable position with time, and the yield of crop from the field receiving treatment.

III 2.2 A. RESEARCH

Research to determine the appropriate tile drain spacing for fields under No-Till Cultivation.

There is a significant change in the methods of tillage by farmers today. There are programs which encourage farmers to change to conservation tillage which in effect reduces the rate and volume of water which leaves the field as surface water. These procedures put an increased demand on sub-surface drainage which should be studied to determine whether present design guidelines are still appropriate.

III 2.3 C. Research

Develop guidelines for the bioremediation and/or disposal of soil and water contaminated by diesel and heating fuel on farms.

a) Methods of bioremediation must be identified and assessed for farm scale situations.
b) Methods of optimizing environmental conditions for bioremediation must be identified and tested on farm sites.
c) Observation criteria for judging the success of the remedial process must be established.
d) Recommendations should be compiled into factsheet.

DESIRABLE

III 3.1 C. RESEARCH

Vegetative Covers for Stream Bank Erosion Control

The choice of vegetative covers for erosion control is dependent on regional climatic, soil and topographical conditions. Regionalized research work is required.

III 3.2 C. SERVICES

Drainage of Fine Textured Soils - Publication

Various drainage projects are conducted in order to solve the problem of draining fine textured soils. They include moling, crowning and the use of small diameter tiles. Proven results must be made available to farmers working on such soils as well as farm contractors. Guidelines as a supplement to the drainage guide of Ontario are presently being prepared.

III 3.3 B. SERVICES

To Investigate and Encourage Development of GPS Systems to Drainage Installation Industry.

Locating tiles post construction adds unnecessary costs to systems that are upgraded. GPS systems could potentially address this problem if applied to new installations and records kept. The same technology could be applied for accurate location of tiles in the future. More beneficial would be the application of this technology to the control of the drainage machinery during installation.

APPENDIX II

COMMITTEE AND SUBCOMMITTEE MEMBERSHIP FOR 1999

AND

PROPOSED SUBCOMMITTEE MEMBERSHIP FOR 2000

ONTARIO AGRICULTURE AND FOOD ENGINEERING RESEARCH AND SERVICES COMMITTEE MEMBERSHIP 1999

Organization	Name	Contact Information	Term End
University of Guelph	Claude Weil Chairperson OAFERSC	Collège d'Alfred de l'Univeristé de Guelph Box 580, 31 St-Paul St., Alfred, Ont. K0B 1A0 Ph : 613-679-2218 x 601 Fax : 613-679-2420 email : cweil@alfredc.uoguelph.ca	Passed expiry date
University of Guelph	Ben Hawkins	Kemptville College of the University of Guelph Parish Bldg, Kemptville, Ontario K0G JJ0 Ph : 613-258-8336 x 458 Fax : 613-258-8285 email : bhawkins@kemptvillec.uoguelph.ca	2000
OMAFRA	Steve Clarke Chairperson Crops Eng. Com	Ministry of Agriculture, Food and Rural Affairs Box 2004, Provincial Bldg, Kempvtille, Ontario, K0G 1J0, email : sclarke@omafra.gov.on.ca Ph : 613-258-8305 Fax : 613-258-8392	Passed expiry date
University of Guelph	Ron Flemings	Ridgetown College of the University of Guelph Ridgetown, Ontario, N0P 2C0 Ph : 519-674-1612 Fax : 519-674-1515 email : rflemings@ridgetownc.uoguelph.ca	Passed expiry date
OMAFRA	George Garland	Ministry of Agriculture, Food & Rural Affairs Resources & Regulations Branch, 1 Stone Road W Guelph, Ontario, N1G 4Y2 Ph : 519-826-3560 Fax : 519-826-3259	Passed expiry date
University of Guelph	Gauri Mittal Chairperson Food Eng. Com	School of Engineering, University of Guelph Guelph, Ontario, N1G 2W1 Ph : 519-824-4120 Fax 519-836-0227 email : mittal@net2.eos.uoguelph.ca	Passed expiry date
OMAFRA	John Johnson Chairperson Livestock Eng. Com.	Ministry of Agriculture, Food and Rural Affairs 667 Exeter Rd, London, Ont. N6E 1L3 Ph : 519-873-4096 Fax : 519-873-4062 email : jjohnson@omafra.gov.on.ca	Passed expiry date
OMAFRA	Jim Myslik Chairperson Rural Env. Eng. Com.	Ministry of Agriculture, Food and Rural Affairs Agriculture & Rural Division, Wellington Place, R.R. 1, Fergus, Ontario, N1M 2W3 Ph : 519-846-0941 Fax : 519-846-8178 email : jmyslik@omafra.gov.on.ca	Passed expiry date
University of Guelph	Lambert Otten represented by Doug Joy	Director, School of Engineering, University of Guelph, Guelph, Ontario, N1G 2W1 Ph: 519-824-4120 Fax : 519-836-0227 email : otten@net2eos.uoguelph.ca	Passed expiry date

Ontario Soyabean Growers' Association	René Petroski	Research & Technology Coordinator, Ontario Soyabean Growers' Association, Box 1199, Chatham, Ontario, N7M 5L8 Ph : 519-352-7730 Fax : 519-352-8983 email : petroski@soybean.on.ca	2001
Ontario Corn Producers' Association	Fred Wagner	Ontario Corn Producers' Association 90 Woodlawn Road W, Guelph, Ont. N1H 1B2 Ph : 519-837-1660 Fax : 519-837-1674 email : wagter@linetap.com	2001
Ontario Soil & Crop Improvement Association	Greg Kitching	Ontario Soil & Crop Improvement Association R R 1, Moffat, Ontario, L0P 1J0 Ph : 905-854-2698 Fax : 519-824-6791 email : kitcholm@islar.ca	Passed expiry date

NOTE : Renewal in membership has been discussed by the committee with Paul Brine and will be implemented this year on the basis of the new guidelines.

LIVESTOCK ENGINEERING SUBCOMMITTEE MEMBERSHIP 1999

(please see proposed list for 2000 at end of document)

Organization	Name	Contact Information	Term End
OMAFRA	John Johnson (Chair)	Ontario Ministry of Agriculture, Food and Rural Affairs 667 Exeter Road, London, Ontario, N6E 1L3 Ph: 519-873-4096 Fax : 519-873-4062 email : jjohnson@omafra.gov.on.ca	Passed expiry date
OMAFRA	Harry Huffman (Chair)	Ontario Ministry of Agriculture, Food and Rural Affairs 667 Exeter Road, London, Ontario, N6E 1L3 Ph: 519-873-4082 Fax : 519-873-4062 email : hhuffman@omafra.gov.on.ca	1999
Univ. of Guelph	Dr. Jan Jofriet	University of Guelph, School of Engineering Guelph, Ontario, N1G 2W1 Ph : 519-824-4120 ext 3642 F. x : 519-836-0227 email : jjofriet@uoguelph.ca	2001
Private Sector	David Kloosterman	Agrotec Construction Ltd R.R. 2, Ilderton, Ontario, N0M 2A0 Ph : 519-666-0453 Fax : 519-666-2430	1999
Private Sector	Jim Cooke	R.R. 1, Walkerton, Ontario, N0G 2V0 Ph : 519-881-1188 Fax : 519-881-3628 email : redbaron@bmts.com	2000
Private Sector	Fred Groenestege	Fred Groenestege Construction Ltd R R 1, Sebringville, Ontario, N0K 1X0 Ph : 519-393-6579 Fax : 393-6532 email : fredg@fgc.ca	2000
OMAFRA	Dr. Neil Anderson	Manager, Health Management, Ontario Ministry of Agriculture, Food and Rural Affairs 2nd Floor, Wellington Place, Fergus Ontario, N1M 1W3 Ph : 519-846-0965 Fax : 519-846-8101 email : nanderson@omafra.gov.on.ca	2001
Shur-Gain Agresearch	Bob Robson	R.R. 2, Burford, Ontario, N0E 1A0 Ph : 519-424-2550 Fax : 519-424-2570 email : shurgain@oxford.net	2002

FOOD ENGINEERING SUBCOMMITTEE MEMBERSHIP 1999

(please see proposed list for 2000 at end of document)

Organization	Name	Contact Information	Term End
Univ. of Guelph	Gauri Mittal, (Chair)	School of Engineering, University of Guelph Guelph, Ontario, N1G 2W1 Ph : 519-824-4120 Fax 519-836-0227 email : mittal@net2.eos.uoguelph.ca	Passed expiry date
Private Sector	Peter Ateba	Effem Foods, Brampton Ontario Ph : 905-853-6000 x 237 Fax : 905-853-7298 email : pateba@iprimus.ca	Passed expiry date
OMAFRA	Hugh Fraser	Ministry of Agriculture, Food and Rural Affairs Horticultural Research Institute of Ontario Vineland Station, Vineland, Ont. L0R 2E0 Ph : 905-562-4147 x 304 Fax : 905-562-5933 email : hfraser@omafra.gov.on.ca	Passed expiry date
Private Sector	Shirley Ho	Oak Leaf Confections Ltd , 440 Comstock Road, Scarborough, Ontario, M1L 2H6 Ph : 1-800-463-7781 Fax : 416-751-3915 email : shirleyho@compaq.net	Passed expiry date
Univ. of Guelph	Frank Holmes	ITA, NRC, Guelph Food Technology Centre University of Guelph, Guelph, Ont. N1G 2W1 Ph : 519-824-4120 x 3877 Fax : 519-824-6631 email : frank.holmes@irap.nrc.ca	Passed expiry date
Ontario Soyabean Growers Marketing Board	Susan Iler	Ontario Soyabean Growers Marketing Board Box 1199, Chatham, Ont. N7M 5L8 Ph : 519-352-7730 fax : 519-352-8983 email : siler@ciaccess.com	Passed expiry date
Private Sector	Diana Iwaniw	Sandwell Inc. Suite 100, 1016 B, Suttton Drive, Burlington, Ontario, L7L 6B8 Ph : 905-319-1666 Fax : 905-319-1801 email : Diwaniw@sandwell.com	2000
Private Sector	Ian MacKinnon	Jamesway Incubator Co. Ltd., 30 High Ride Court, Cambridge Ont., N1R 7L3 Ph : 519-624-4646 Fax : 519-624-5803 email : ian_mack@jamesway.com	2000
Private Sector	Ping F. Wu	Ansatec, 8 Silas Hill Dirve, North York, Ont. M2J 2X9 Ph : 416-726-6278 Fax : 416-490-6659 email : pingwu@compuserve.com	2000
Private Sector	Robin L. Williams	Consumer Foods Division, Robin-Hood Multifoods Inc., 191 Attwell Drive, Unit 4, Etobicoke, Ontario, M9W 5Z2 Ph : 416-675-2541 Fax : 416-675-6194 email : robin.williams@robinhood.ca	2001

Private Sector	Albert Verbeem	Nabisco/Christie Brown Co., 2150 Lakeshore Blvd, Toronto, Ont. M8V 1A3 Ph : 416-503-6031 Fax : 416-503-6029 email : averbeem@nabisco.ca	2001
Food Processing & Quality Improvement Program	Punidadas Piyasena	Food Processing & Quality Improvement Program Agriculture & Agrifood Canada, 95 Stone Rd W, Box 3650, Guelph, Ont. N1H 8J7 email : piyasenaP@em.agr.ca	2000
Ontario Bean Producers	Bob Fotheringham	Ontario Bean Producers, 140 Raney Cres., London, Ontario, N6L 1C3 Ph : 519-652-3566 Fax 519-263-3034	2001
Private Sector	Craig Richardson	Principal Marques Inc., 21 Medulla Avenue, Etobicoke, Ontario, M8Z 5L7 Ph : 416-231-5651 Fax : 416-231-8900	2000

RURAL ENGINEERING SUBCOMMITTEE MEMBERSHIP 1999

Organization	Name	Contact Information	Term End
OMAFRA	Jim Myslik (Chair)	Ministry of Agriculture, Food and Rural Affairs Agriculture & Rural Division, Wellington Place, R.R. 1, Fergus, Ontario, N1M 2W3 Ph : 519-846-0941 Fax : 519-846-8178 email : jmyslik@omafra.gov.on.ca	Passed expiry date
Univ. of Guelph	Hugh Whiteley	School of Engineering, University of Guelph Guelph, Ontario, N1G 2W1 Ph : 519-824-4120 Fax : 519-836-0227	Passed expiry date
OMAFRA	Robert Stone	Ministry of Agriculture, Food and Rural Affairs Agriculture & Rural Division Box 8200, Brighton, Ont. K0K 1H0 Ph : 613-475-1630 Fax : 613-475-3835	Passed expiry date
OMAFRA	Sid Van der Veen	Ministry of Agriculture, Food & Rural Affairs Resources and Planning Branch, Box 1030, Guelph Agricultural Centre, Guelph, Ontario, N1H 6N1 Ph : 519-826-3552 Fax : 519-826-3259	Passed expiry date
Private Sector	Ross Irwin or designate	Delegate, Land Improvement Contractors of Ontario, 24 Marilyn Drive, Guelph, Ont N1H 8E9 Ph : 519-822-3993	Passed expiry date
Univ. of Guelph	Claude Weil	Collège d'Alfred de l'Univeristé de Guelph Box 580, 31 St-Paul St., Alfred, Ont. K0B 1A0 Ph : 613-679-2218 x 601 Fax : 613-679-2420 email : cweil@alfredc.uoguelph.ca	Passed expiry date
Univ. of Guelph	Ron Fleming	Ridgetown College of the University of Guelph Ridgetown, Ontario, N0P 2C0 Ph : 519-674-1612 Fax : 519-674-1515 email : rflemings@ridgetownc.uoguelph.ca	Passed expiry date
OMAFRA	Don Hilborn	Ministry of Agriculture, Food and Rural Affairs Agriculture & Rural Division, Box 666, Hwy 59 N, Woodstock, Ontario, N4S 7Z5 Ph : 519-537-6621 Fax : 519-539-5351	Passed expiry date
OPPMB	Sam Bradshaw	OPPMB, Box 740, 15 Waulron, Street, Etobicoke, Ontario, M9C 5H3 Ph : 416-621-1874 x 212 Fax : 416-621-8720	2000
Grand River Conservation Authority	Tracy Ryan	Grand River Conservation Authority, 400 Clyde Road, Box 729, Cambridge, Ontario, N1R 5W6 Ph : 519-621-2761 x 269 Fax : 519-621-4844	2000

PROPOSED SUBCOMMITTEE MEMBERSHIP FOR 2000

LIVESTOCK ENGINEERING SUBCOMMITTEE

Organization	Name	Contact Information	Term End
OMAFRA	John Johnson (Chair)	Ontario Ministry of Agriculture, Food and Rural Affairs 667 Exeter Road, London, Ontario, N6E 1L3 Ph: 519-873-4096 Fax : 519-873-4062 email : jjohnson@omafra.gov.on.ca	Passed expiry date
OMAFRA	(Secretary)		2003
Univ. of Guelph	Dr. Jan Jofriet	University of Guelph, School of Engineering Guelph, Ontario, N1G 2W1 Ph : 519-824-4120 ext 3642 Fax : 519-836-0227 email : jjofriet@uoguelph.ca	2001
Private Sector	Jim Cooke	R.R. 1, Walkerton, Ontario, N0G 2V0 Ph : 519-881-1188 Fax : 519-881-3628 email : redbaron@bmts.com	2000
Private Sector	Fred Groenestege	Fred Groenestege Construction Ltd R R 1, Sebringville, Ontario, N0K 1X0 Ph : 519-393-6579 Fax : 393-6532 email : fredg@fgc.ca	2000
OMAFRA	Dr. Neil Anderson	Manager, Health Management, Ontario Ministry of Agriculture, Food and Rural Affairs 2nd Floor, Wellington Place, Fergus Ontario, N1M 1W3 Ph : 519-846-0965 Fax : 519-846-8101 email : nanderson@omafra.gov.on.ca	2001
Shur-Gain Agresearch	Bob Robson	R.R. 2, Burford, Ontario, N0E 1A0 Ph : 519-424-2550 Fax : 519-424-2570 email : shurgain@oxford.net	2002
Private Sector	One of : David Waud (Sun North), Murray Gould or Paul Fallis (BSM Agri. Ltd)		2003
Private Sector	One of : Ray Jacobs, (Landmark Builders) or Ron Mac Donald (Agviro Inc.)		2003

PROPOSED SUBCOMMITTEE MEMBERSHIP FOR 2000

FOOD ENGINEERING SUBCOMMITTEE

Organization	Name	Contact Information	Term End
Food Processing & Quality Improvement Program	Punidadas Piyasena (Chair)	Food Processing & Quality Improvement Program Agriculture & Agrifood Canada, 95 Stone Rd W, Box 3650, Guelph, Ont. N1H 8J7 email : piyasenaP@em.agr.ca	2000
Univ. of Guelph	Gauri Mittal, (Past-Chair)	School of Engineering, University of Guelph Guelph, Ontario, N1G 2W1 Ph : 519-824-4120 Fax 519-836-0227 email : mittal@net2.eos.uoguelph.ca	Passed expiry date
Private Sector	Peter Ateba	Effem Foods, Brampton Ontario Ph : 905-853-6000 x 237 Fax : 905-853-7298 email : pateba@iprimus.ca	Passed expiry date
OMAFRA	Hugh Fraser	Ministry of Agriculture, Food and Rural Affairs Horticultural Research Institute of Ontario Vineland Station, Vineland, Ont. L0R 2E0 Ph : 905-562-4147 x 304 Fax : 905-562-5933 email : hfraser@omafra.gov.on.ca	Passed expiry date
Private Sector	Shirley Ho	Oak Leaf Confections Ltd , 440 Comstock Road, Scarborough, Ontario, M1L 2H6 Ph : 1-800-463-7781 Fax : 416-751-3915 email : shirleyho@compaq.net	Passed expiry date
Univ. of Guelph	Frank Holmes	ITA, NRC, Guelph Food Technology Centre University of Guelph, Guelph, Ont. N1G 2W1 Ph : 519-824-4120 x 3877 Fax : 519-824-6631 email : frank.holmes@irap.nrc.ca	Passed expiry date
Ontario Soyabean Growers Marketing Board	Susan Iler	Ontario Soyabean Growers Marketing Board Box 1199, Chatham, Ont. N7M 5L8 Ph : 519-352-7730 fax : 519-352-8983 email : siler@ciaccess.com	Passed expiry date
Private Sector	Diana Iwaniw	Sandwell Inc. Suite 100, 1016 B, Suttton Drive, Burlington, Ontario, L7L 6B8 Ph : 905-319-1666 Fax : 905-319-1801 email : Diwaniw@sandwell.com	2000
Private Sector	Ian MacKinnon	Jamesway Incubator Co. Ltd., 30 High Ride Court, Cambridge Ont., N1R 7L3 Ph : 519-624-4646 Fax : 519-624-5803 email : ian_mack@jamesway.com	2000

Private Sector	Ping F. Wu	Ansatec, 8 Silas Hill Dirve, North York, Ont. M2J 2X9 Ph : 416-726-6278 Fax : 416-490-6659 email : pingwu@compuserve.com	2000
Private Sector	Robin L. Williams	Consumer Foods Division, Robin-Hood Multifoods Inc., 191 Attwell Drive, Unit 4, Etobicoke, Ontario, M9W 5Z2 Ph : 416-675-2541 Fax : 416-675-6194 email : robin.williams@robinhood.ca	2001
Private Sector	Albert Verbeem	Nabisco/Christie Brown Co., 2150 Lakeshore Blvd, Toronto, Ont. M8V 1A3 Ph : 416-503-6081 Fax : 416-503-6029 email : averbeem@nabisco.ca	2001
Ontario Bean Producers	Bob Fotheringham	Ontario Bean Producers, 140 Raney Cres., London, Ontario, N6L 1C3 Ph : 519-652-3566 Fax 519-263-3034	2001
Private Sector	Craig Richardson	Principal Marques Inc., 21 Medulla Avenue, Etobicoke, Ontario, M8Z 5L7 Ph : 416-231-5651 Fax : 416-231-8900	2000

APPENDIX III

TERMS OF REFERENCE

APPENDIX III

TERMS OF REFERENCE FOR THE COMMITTEE AND SUBCOMMITTEES

The Agricultural Engineering Research and Services Committee was commissioned at the October, 1972 meeting of OASCC. A reorganization of the committee to add subject matter subcommittees was accepted in 1981. In 1986, a recommendation was accepted by OASCC to expand the subcommittees to include Food Engineering and to rename the overall committee to the Ontario Agriculture and Food Engineering Research and Services Committee. In 1991, a recommendation was accepted by OASCC to rename the Soil and Water subcommittee to Rural Environment Engineering subcommittee. In 1992, a recommendation was accepted by OASCC to rename the Structures and Environment subcommittee to Structures and Building Environment subcommittee. In 1994, a recommendation was accepted by OASCC to rename three subcommittees; the On-Farm Energy & Processing, Power & Machinery and Structures & Building Environment subcommittees became Systems Engineering, Crops Engineering and Livestock Engineering, respectively. This facilitated harmonization with the University of Guelph's research programs. In 1996, the Systems Engineering Subcommittee was amalgamated with the other four subcommittees. The 1999 subcommittees are : Crops Engineering Subcommittee, Rural Environment Engineering Subcommittee, Livestock Engineering Subcommittee and Food Engineering Subcommittee.

Duties and Terms of Reference of the Ontario Agriculture and Food Engineering Research and Services Committee

1. To review reports submitted by the subject matter subcommittees.

2. To assess and establish priorities for engineering research and service programs.

3. To present reports and resolutions to the OASCC outlining the needs for engineering research and service and to

    a) include cost/benefit information where available;
    b) recommend facilities and personnel that will be required to accomplish these objectives;
    c) recommend where the research should be carried out;
    d) recommend how monies might be obtained or freed to conduct new research.

4. To meet and assess research and information transfer progress as provided by subject matter subcommittees.

5. The Agriculture and Food Engineering Research and Services Committee will appoint the Chairmen of the subject matter subcommittees for a three-year term of office and will approve the membership of the subject matter subcommittees.

Membership

a) Appointed by Institutions

Representative of the School of Engineering, University of Guelph.
Representative of each of the Ontario Colleges of Agricultural Technology.
Representative of the Engineering Programs Unit, Resources & Regulations Branch.

b) Representing subject matter subcommittees

Chairperson of the Crops Engineering Subcommittee.
Chairperson of the Rural Environment Engineering Subcommittee.
Chairperson of the Livestock Engineering Subcommittee.
Chairperson of the Food Engineering Subcommittee.

Subject Matter Subcommittees

Four subcommittees cover the subjects into which agricultural engineering has been traditionally divided.

a) Crops Engineering (was Power and Machinery) - Buildings, equipment and integrated production systems in the area of crops from an engineering perspective.

b) Rural Environment Engineering - Pollution abatement technology, drainage, irrigation, land development, all environmental issues outside structures.

c) Livestock Engineering - Farm buildings and their internal environment, equipment and integrated production systems in the area of livestock from an engineering perspective.

d) Food Engineering - Processes, equipment and technology related to the production aspects of food processing.

Duties and Terms of Reference of Subject Matter Subcommittees

1. To review research work and service programs being carried out in Ontario and elsewhere.

2. To disclose problems that face the agricultural industry and which require investigation.

3. To assess and suggest priorities for new research, development, service and information transfer programs and recommend which programs presently underway should be continued, expanded or terminated.

4. To make recommendations on:

    a) planning and conducting cooperative research, development, service and information transfer projects, and

    b) dividing and allocating research projects in order to provide coordination and to avoid unnecessary duplication between stations.

5. To estimate, where possible, costs involved in the conduct of new programs and to supply cost/benefit information.

6. To recommend, where possible, how monies might be obtained or freed to expand current programs or conduct new programs.

7. To supply a written report, at least annually, to the Agriculture and Food Engineering Research and Services Committee.

8. To participate in the planning and execution of meetings: to share research, development, service and information progress and to determine problem areas that need to be addressed.

APPENDIX IV

CROPS ENGINEERING SUBCOMMITTEE REPORT

The top two Crops Engineering Subcommittee priorities are listed below.

1. **Solid & Liquid Manure plus bio-solids Applicators Ability to Apply Manure & bio-solids Uniformly on the Land At Desired Rates and odour control.**

To develop better application equipment that can apply solid, and liquid manure plus bio-solids evenly at target rates specified by a nutrient management plan . All application methods must consider now to reduce odour. This research objective is to reduce the cost of nutrients per unit cost of production, plus reducing the potential of pollution.

- Acquire information that can be used to fine tune the application rates and control odour.

- Identify future research needs in the design of solid and liquid manure plus bio-solid spreaders.

2. **Grain and Forage Processing (Drying)**

Research is needed in new technology for drying equipment suitable for food grade corn drying, and control systems for regulating that equipment. Ontario corn used in wet milling and for dry-milled food products does not need to be dried to 15% moisture as both industries mill damp grain (i.e., 18-20% wet basis). Also the development of drying systems has not kept pace with the growing industry in conventional and organic production of alternate crops . Producers are forced to adopt a trial-and-error approach to drying or dehydrating, usually with modified tobacco bulk curing kilns or commercial tray dryers.

Research is needed in new technology for drying equipment suitable for food grade corn drying, and control systems for regulating that equipment

- Basic research is required to investigate the requirements of drying phytomedicinals, nutraceuticals and horticultural herbage and root crops (e.g., ginseng, echinacea, garlic).

- Research is needed to design new equipment or modify existing designs to accommodate the new crops .

- Research into low temperature storage of damp grain

- Designs to reduce cost and energy consumption, while maintaining crop quality during the drying process.

CROPS ENGINEERING

RESEARCH AND SERVICES SUBCOMMITTEE

2000 REPORT TO

ONTARIO AGRICULTURAL AND FOOD ENGINEERING

RESEARCH AND SERVICES COMMITTEE

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6.0 EMERGING ISSUES

7.0 REPORT OF ACTION TAKEN ON PREVIOUS YEAR'S RECOMMENDATION

8.0 SUMMARY OF DISTRIBUTION OF RECOMMENDATIONS

9.0 DETAILED RECOMMENDATIONS

10.0 APPENDIX

.1 Complete List of Research and Services Needs in Priority listing

.2 Agenda of 1999 meeting

.3 Committee Membership

LIST OF ACRONYMS

OMAFRA	Ontario Ministry of Agriculture, Food and Rural Affairs
ARIO	Agricultural Research Institute of Ontario
U of G	University of Guelph
OATI	Ontario Agricultural Training Institute
OSCIAOn	tario Soil and Crop Improvement Association
RCAT	Ridgetown College of Agricultural Technology
CARC	Canadian Agricultural Research Counci!
AAFC	Agriculture and Agri-Food Canada
CC	Canada Committees

1.0 EXECUTIVE SUMMARY

The Crops Engineering sub-committee prioritised the emerging issues and separated them into research needs and non R&D needs.

The following Research 2 items require a high priority:

RECOMMENDATION NUMBER 1

Solid & Liquid Manure plus bio-solids Applicators Ability to Apply Manure & bio-solids Uniformly on the Land At Desired Rates and odour control.

To develop better application equipment that can apply solid, and liquid manure plus bio-solids evenly at target rates specified by a nutrient management plan . All application methods must consider now to reduce odour. This research objective is to reduce the cost of nutrients per unit cost of production, plus reducing the potential of pollution.

1. Acquire information that can be used to fine tune the application rates and control odour.

2. Identify future research needs in the design of solid and liquid manure plus bio-solid spreaders.

PRIORITY RESEARCH II Grain and Forage Processing (Drying)

Details:

Research is needed in new technology for drying equipment suitable for food grade corn drying, and control systems for regulating that equipment. Ontario corn used in wet milling and for dry-milled food products does not need to be dried to 15% moisture as both industries mill damp grain (i.e., 18-20% wet basis). Also the development of drying systems has not kept pace with the growing industry in conventional and organic production of alternate crops . Producers are forced to adopt a trial-and-error approach to drying or dehydrating, usually with modified tobacco bulk curing kilns or commercial tray dryers.

Research is needed in new technology for drying equipment suitable for food grade corn drying, and control systems for regulating that equipment

1. Basic research is required to investigate the requirements of drying phytomedicinals, nutraceuticals and horticultural herbage and root crops (e.g., ginseng, echinacea, garlic).

2. Research is needed to design new equipment or modify existing designs to accommodate the new crops

3. Research into Low temperature Storage of Damp Grain

4. Designs to reduce cost and energy consumption, while maintaining crop quality during the drying process.

2.0 INTRODUCTION

This report is the summary of the discussions held by our sub-committee, on October 17,1999, to discuss and review last year's recommendation and to identify emerging issues in the field of crops engineering. The issues identified were broken down into two categories; those requiring research and development, and those requiring non R&D input. Some requiring non R&D input were to be handled by selected members of the committee within the next year.

3.0 SUBCOMMITTEE ACTIVITIES

During the past year, we have had one meeting of this sub-committee.

At this meeting it was decided to revise recommendations, however the recommendations would stay the same in principle.

4.0 STATE OF THE INDUSTRY

Ontario's agriculture and food industry contributes $25 billion to the provincial economy every year, and employs some 640,000 people. It is Ontario's second largest industry. To remain competitive, farmers must expand and adopt new, more efficient production methods. Some times expanding or new farm operations encounter serious conflict with neighbours.

Farm, rural, environmental, and urban groups are studying the issues that put farmers in conflict with their neighbours. In Ontario food production and rural housing in the most part are neighbours. Good neighbours need to trust each other, one way to build trust is by having the agricultural operations do a Nutrient Management Plan.

Currently there is a consultation of the rural community with respect to what can be done to ensure that Ontario has adequate food supply, food safety, environmentally sound farm practices and minimum conflicts.

5.0 ACHIEVEMENTS

Achievements of the Crop Engineering Sub Committee over the past year are listed below.

Standby Power for Farms

During the Eastern Ontario ice storm of January 1998, an estimated 85% of all farms did not have the proper standby power or tractor to operate their generators. This lead to generalized panic, loss of production, goods and revenue. Adequate standby power provides security and reduces stress as well as fatigue. There has been a major research project that has focused on resolving a number of the stand-by power systems issues of importance to future similar disasters. They are generator safety, connections for sharing systems between farms, management, education/training, and maintenance. A computer program to properly size farm generators has been developed. This project has also produced a report on in field evaluation of the quality of power produced by on farm generators

Canadian Standards Association Technical Committee establishing standards for extremity lighting and equipment visibility

- M669-97 (ANSI/ASAE S279.9 Jul93) Lighting and Marketing of Agricultural Field Equipment on Highways
- M673-99 (ANSI/ASAE S338.4 Nov97) Equipment for Agriculture – Safety Chain for Towed Equipment
- M671 – 99 (ASAE S276.5 Nov97) Slow – Moving Vehicle Identification Emblem
- M675-99 (ASAE S365.3 Jul97) Braking System Test Procedures and Braking Performance Criteria for Agricultural Field Equipment

A large number of farmers have been hosted at the wind tunnel at Ridgetown College. This 50 foot long wind tunnel is used to show spray drift leaving nozzles mounted on a stationary spray boom. A wide variety of nozzle sizes, nozzle types, spray pressures and wind speeds can be used to show how to reduce drift. Many farmers have come here and spent a couple of hours to "test drive new spray tips". They can try different makes and models of nozzles inside a heated teaching shop. Carefully placed lights in the roof of the wind tunnel highlight the spray drift leaving the nozzles. A darkened shop accentuates the drifting droplets. The wind speed is variable up to 20 kph. Visitors can use their eyes and face to gauge the differences in spray drift from different nozzles.

Ultraviolet dyes and water-sensitive paper have been used to show farmers where spray droplets are landing in the canopy, as well as the quality of the spray – size of droplets. Both these techniques provide a means to see where the droplets end up. Are we getting to the target? Do we have good coverage?

6.0 EMERGING ISSUES

Spray Drift

Now that farmers have available to them herbicide resistant crops, it is more important than ever to understand the causes of spray drift and techniques to minimize this drift. Since some of these herbicides are non-selective and sprayed after most crops have emerged, the risk of drift injury is very real.

Genetically Modified Engineered Foods: (GMO)

Segregate Harvest and Storage of GMO Foods

The controversy swirling around biotech-based crops is creating a great deal of uncertainty about seed purchasing decisions. And it could lead to some fundamental changes in the way you market your crops. Protests about GMO crops will mostly not die down. In real life perception is reality and farmers can grow GMO crops however having a market is some thing else. Farmers are being asked to be market wise when deciding what to grow

Farmers who decide to grow some GMO crops must be ready to segregate harvest and storage of these crops. This will also mean that companies down the food delivery line like processors will have to segregate also.

7.0 REPORT OF ACTION TAKEN ON PREVIOUS YEAR'S RECOMMENDATIONS

ONTARIO AGRICULTURAL AND FOOD ENGINEERING RESEARCH AND SERVICES COMMITTEE

CROPS ENGINEERING RECOMMENDATION TO:

AGRICULTURE & AGRI-FOOD CANADA, AGRICULTURAL RESEARCH INSTITUTE OF ONTARIO, ONTARIO MINISTRY OF AGRICULTURE, FOOD AND RURAL AFFAIRS, CANADA COMMITTEES AND CANADIAN AGRICULTURAL RESEARCH COUNCIL

RESEARCH PRIORITY # I

Solid & Liquid Manure Plus Bio-solids Applicators Ability to Apply Manure & Bio-solids Uniformly on the Land at Desired Rates

Details:
To develop better application equipment that can apply solid, and liquid manure plus bio-solids evenly at target rates specified by a nutrient management plan, thereby improving the overall efficiency of nutrient application. This research objective is to reduce the cost of nutrients per unit cost of production, plus reducing the potential for pollution.

- Acquire information that can be used to determine the application rates.
- Identify future research needs in the design of solid and liquid manure plus bio-solid spreaders.

Background and Cost/Benefits:
If farmers do not voluntarily handle their manure properly, then rules may be required to force them to do so. Good quality manure application equipment will encourage the farmer to use the manure as a valued nutrient, reducing off-farm fertilizer purchases (making the farm more competitive) and reducing environmental losses (making the farm more environmentally acceptable); a "win/win" situation. In Ontario, an estimated 37 million tons of manure is applied to the land base. This manure contains 156,000 tons of nitrogen, 79,000 tons of phosphate and 162,000 tons of potash. If fully used to replace commercial fertilizer, it would have a 1995 value of 200 million dollars. Conversely, if not treated properly it could have a negative value as a pollution source.

Preliminary research has shown that existing manure application equipment is very difficult to calibrate and does not apply manure evenly across the desired application band. If better equipment can be developed, farmers will have greater confidence that manure is applied to target areas and they will reduce commercial fertilizer use. This will improve the profitability of the farm and reduce the over application of nutrients lowering possible adverse effects on the environment. Finally, Ontario is a major manufacturer of manure application equipment. If Ontario develops better technology, it is expected that the global demand for our technology will increase. This has the potential of increasing the manufacturing jobs in this field.

Resources:
OMAFRA's Engineering and Soils and Crops Specialists are currently working on preliminary projects to develop better equipment. Husky Farm Equipment, John Deere Welland Works, Agri-Food Labs, Agriculture and Agri-Food Canada and OMAFRA have initiated a 4 year MII project to develop precision manure application equipment.

RESPONSE:

Crops Engineering Subcommittee

Research # II.1.1-B

Solid & Liquid Manure plus bio-solids Applicators Ability to Apply Manure & bio-solids Uniformly on the Land At Desired Rates and Control Odour.

Response:

1. *Agricultural Research Institute of Ontario - only provided responses for new recommendations*

AAFC

GPCRC - No activity
SCPFRC - Resources:

SCPFRC has recently initiated a 3year project in partnership with Ontario Pork, the Agricultural Adaptation Council, and Nuhn industries to investigate swine manure storage and application methods which conserve nutrients, protect the environment from chemical or biological contaminants, and benefit crop yield through suppression of soilborne diseases.

8.0 SUMMARY OF DISTRIBUTION OF RECOMMENDATIONS

Recommendation	AAFC	ARIO	CC	CARC	OMAFRA	OTHER
Priority I (Research) **Solid & Liquid Manure plus Bio-solids Applicators Ability to Apply Manure & Bio-Solids Uniformly on the Land and control odour.** 1. Acquire information that can be used to determine the application rates. 2. Identify future research needs in the design of solid and liquid manure applicators.	x	x	1,2	x	x	
Priority II (Research) Grain and Forage Processing (Drying) § Research is needed in new technology for drying equipment suitable for food grade corn drying, and control systems for regulating that equipment § Basic research is required to investigate the requirements of drying phytomedicinals, nutraceuticals and horticultural herbage and root crops (e.g., ginseng, echinacea, garlic). § Research is needed to design new equipment or modify existing designs to accommodate the new crops § Research into Lowtemperature Storage of Damp Grain	x	x	1,2	x	x	

§ Designs to reduce cost and energy consumption, while maintaining crop quality during the drying process.						

Canada Committees: 1-Natural Resources 2-Crops 3-Animals 4-Food

FS means Farm Safety And M means Manufacture(s)

9. DETAILED RECOMMENDATION:

ONTARIO AGRICULTURAL AND FOOD ENGINEERING RESEARCH AND SERVICES COMMITTEE
CROPS ENGINEERING
RECOMMENDATION TO:

AGRICULTURE & AGRI-FOOD CANADA,
AGRICULTURAL RESEARCH INSTITUTE OF ONTARIO,
ONTARIO MINISTRY OF AGRICULTURE, FOOD AND RURAL AFFAIRS
CANADA COMMITTEES AND CANADIAN AGRICULTURAL RESEARCH COUNCIL

PRIORITY RESEARCH I

Solid & Liquid Manure plus bio-solids Applicators Ability to Apply Manure & bio-solids Uniformly on the Land At Desired Rates and Control Odour.

DETAILS:

To develop better application equipment that can apply solid, and liquid manure plus bio-solids evenly at target rates specified by a nutrient management plan. All application methods must consider now to reduce odour. This research objective is to reduce the cost of nutrients per unit cost of production, plus reducing the potential of pollution and rural conflict.

1. Acquire information that can be used to fine tune the application rates and odour control.

2. Identify future research needs in the design of solid and liquid manure plus bio-solid spreaders.

BACKGROUND and COST/BENEFITS

If farmers do not voluntarily handle their manure properly then rules may be required to force farmers to do so. Good quality manure application equipment will encourage the farmer to use the manure as a valued nutrient reducing off-farm fertilizer purchases (making the farm more competitive) and reducing environmental losses (making the farm more environmentally acceptable). A "win/win" situation.

In Ontario, an estimated 37 million tons of manure is applied to the land base. This manure 156,000 tons of nitrogen, 79,000 tons of phosphate and 162,000 tons of potash. If fully used to replace commercial fertilizer, it would have a 1995 value of 200 million dollars. Conversely, if not treated properly it could have a negative value as a pollution source. Preliminary research has shown that existing manure application equipment is very difficult to calibrate and does not apply manure evenly across the desired application band.

If better equipment can be developed, farmers will have greater confidence that manure is applied to target areas and they will reduce commercial fertilizer use. This will improve the profitability of the farm and reduce the over application of nutrients lowering possible adverse effects on the environment.
Finally, Ontario is a major manufacturer of manure application equipment. If Ontario develops better technology it is expected that the global demand for our technology will increase. This has the potential for an increase of manufacturing jobs in this field.

Resources

OMAFRA's Engineering and Soil and Crop Specialists are currently working on preliminary projects to develop better equipment.

Husky Farm Equipment, John Deere Welland Works, Agri-Food Labs, Ag Can and OMAFRA have initiated a 4 year MII project to develop precision manure application equipment. See Appendix for update on this project.

ONTARIO AGRICULTURAL AND FOOD ENGINEERING RESEARCH AND SERVICES COMMITTEE

CROP ENGINEERING RECOMMENDATION TO:

AGRICULTURE & AGRI-FOOD CANADA AGRICULTURAL RESEARCH INSTITUTE OF ONTARIO, ONTARIO MINISTRY OF AGRICULTURE, FOOD AND RURAL AFFAIRS CANADA COMMITTEES, CANADIAN AGRICULTURAL RESEARCH COUNCIL

PRIORITY RESEARCH II GRAIN and FORAGE PROCESSING (Drying)

Details:

Research is needed in new technology for drying equipment suitable for food grade corn drying, and control systems for regulating that equipment. Ontario corn used in wet milling and for dry-milled food products does not need to be dried to 15% moisture as both industries mill damp grain (i.e., 18-20% wet basis). Also the development of drying systems has not kept pace with the growing industry in conventional and organic production of alternate crops . Producers are forced to adopt a trial-and-error approach to drying or dehydrating, usually with modified tobacco bulk curing kilns or commercial tray dryers.

§ Research is needed in new technology for drying equipment suitable for food grade corn drying, and control systems for regulating that equipment

§ Basic research is required to investigate the requirements of drying phytomedicinals, nutraceuticals and horticultural herbage and root crops (e.g., ginseng, echinacea, garlic).

§ .

§ Research is needed to design new equipment or modify existing designs to accommodate the new crops

§ Research into Lowtemperature Storage of Damp Grain

§ Designs to reduce cost and energy consumption, while maintaining crop quality during the drying process.

Background:

The food grade corn industry in Ontario could potentially expand from its present level of about 2 million bushels up to 20 million bushels or more annually if we develop the varieties and the production system to assure delivery of consistent quality. With the pending release of white and food grade yellow corn varieties for Ontario conditions, there should be an increased export

opportunity for snack food corn products. Brian Doidge has estimated that the potential for expansion may be up to $55 million annually (Source *Food Grade Corn: Expanding the Industry in Ontario*, a report published by Ridgetown College, University of Guelph, July, 1997). Ontario corn would find wider acceptance in local and global industrial markets if it was assured free of physical and chemical damage.

Cost \ Benefits

In about one out of four or five years, poor harvest conditions necessitate drying regimes that cause unacceptable damage, and this is often not visibly apparent to the buyer. Consequently some industrial buyers prefer to import American corn rather than buy locally. Advanced dryer controls and drying systems would save an estimated $68 million annually through only the reduction of fuel energy used to over dry corn, and the minimization of hidden losses in storage and handling.

Resources:

The School of Engineering at the University of Guelph maintains ongoing research in crop drying and storage technology (Drs. R. Brown and L. Otten). Current projects involve aeration and cold temperature damp corn storage, low temperature drying control systems and drying guidelines for food grade corn. At the Ridgetown College campus Helmut Spieser is active in extension of grain drying technology and some research activity. Dr. Judith Fregeau Reid at ECORC in Ottawa works in the area of corn quality as it relates to milling requirements and also evaluation screening of corn varieties.

APPENDIX

2000 COMPLETE LIST OF CROPS ENGINEERING RESEARCH AND SERVICES NEEDS:

RECOMMENDATION 1 (Research)

Solid & Liquid Manure plus Bio-solids Applicators Ability to Apply Material Uniformly on the Land At Desired Rates and Odour Control

To investigate the ability of solid and liquid manure plus bio-solids applicators to spread manure and bio-solids in a uniform coating on the land and with minimum odour. Thereby improving the overall efficiency of nutrient application. This research objective is to reduce the cost of nutrients per unit cost of production, plus reducing the potential of pollution and reduce rural conflict.

Farmers are being encouraged to develop nutrient management plans for their farms and be good neighbours. To do this they need application equipment that will apply manure and bio-solids evenly and at the desired rates and at minimum odour. This is the goal of this research.

1. Acquire information that can be used to determine the application rates and odour control.
2. Identify future research needs in the design of solid and liquid manure applicators.

RECOMMENDATION 2 (Research) Grain and Forage Processing (Drying)

Research is needed in new technology for drying equipment suitable for food grade corn drying, and control systems for regulating that equipment. Ontario corn used in wet milling and for dry-milled food products does not need to be dried to 15% moisture as both industries mill damp grain (i.e., 18-20% wet basis). Also the development of drying systems has not kept pace with the growing industry in conventional and organic production of alternate crops . Producers are forced to adopt a trial-and-error approach to drying or dehydrating, usually with modified tobacco bulk curing kilns or commercial tray dryers.

§ Research is needed in new technology for drying equipment suitable for food grade corn drying, and control systems for regulating that equipment

§ Basic research is required to investigate the requirements of drying phytomedicinals, nutraceuticals and horticultural herbage and root crops (e.g., ginseng, echinacea, garlic).

§ Research is needed to design new equipment or modify existing designs to accommodate the new crops.

§ Research into Low temperature Storage of Damp Grain.

§ Designs to reduce cost and energy consumption, while maintaining crop quality during the drying process.

RECOMMENDATION 3 (Service) Equipment Safety

There are a number of safety issues that need to be addressed urgently by the public and private sector.
Specifically the safety issues are:

.1 Develop a education and information program to increase visibility of agricultural equipment on public roads in dark or poor lighting conditions.

.2 Develop standard for the use of reflective tape (similar to type on transport trucks) on farm machinery on public roads for front and rear viewing of other road traffic in low and no-light conditions.

.3 There is a need for Short Line Companies to review their equipment designs in light of farm safety

.4 Develop guidelines into cleaning procedures of "sealed" oxygen-limiting silos to reduce exposure to toxic gases.

RECOMMENDATION NUMBER 4 No-TILL SYSTEMS

No-till is fast becoming an accepted farming system. Basic and applied information is required to deal with no till and nutrient management issues.

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RECOMMENDATION 5 (Research) Site-specific Crop Management

Basic and applied information is required to sustain the precision farming movement. Information is needed to assess for the use of differential global positioning systems data, from yield monitors and crop sensors for site-specific crop management. (not hardware development).
Site-specific Crop Management

Research is needed:

1. Determining the right Interpretation of combine yield maps in terms of subsequent crop nutrient management .

1. Application of GPS-guided application technology and GIS mapping for spatially-variable input rates needs to be developed.

2. Long-term research & assessment of the yield effects and sustainability of variable input agriculture is necessary.

RECOMMENDATION NUMBER 6 (Service) Pest Control

1. To demonstrate alternative Pest Control Measures which may include; propane flamer, plastic-lined interception ditches, electrical discharge weed control, hot water vegetation control and mechanical pest removal, etc.

2 Information on these alternative pest control measures needs to be available so producers can effectively evaluate its potential in his system. This technology transfer could include; in field demonstrations, producer workshops, educational videotapes, and factsheets.

Service/Training is needed on:

(a) Performance of alternative pest control measures.
(b) Limitations of effectiveness of alternative control measures.
(c) Understanding the development of the pest and susceptible periods.
(d) Importance of proper environmental conditions for optimum pest control.

RECOMMENDATION NUMBER 7 (Research) Off Road Emissions

With California introducing emissions standards for diesel engines in January 1986, it will only be a matter of time before standards are demanded for Ontario. Now is the time for industry and government to get involved so that the standards will reflect Ontario Conditions. Research is needed to help in development of these emission standards. Ontario is starting an automobile emission testing program will there also be one for off road equipment.

RECOMMENDATION NUMBER 8 (Service) Technology Transfer

There are a number of topics where little information is available to the consumers with respect to farm machinery which have been identified by the committee members.

1. Growing concern with respect to compaction and the effect of deep versus shallow compaction especially for fine textured soils.

2. Markers for Sprayers Information in the form of a factsheet describing some of the technical aspects of the markers which also points out the benefits of this device would be useful.

RECOMMENDATION NUMBER 9 (Service)

SOFT-WARE, MACHINERY MANAGEMENT

There is very little current work in this area. More farmer friendly agricultural computer soft-ware is needed that can run on personal computers.

10.1 Complete list of Research and Services Needs in a Priority Listing

RESEARCH & SERVICE RECOMMENDATIONS

for 2000

RECOMMENDATION	
1	(RESEARCH) MANURE & BIO SOLID APPLICATION/ODOUR CONTROL
2	(RESEARCH) GRAIN / FORAGE PROCESSING
3	(SERVICE) EQUIPMENT SAFETY
4	(RESEARCH) NO TILL SYSTEMS
5	(RESEARCH) SITE SPECIFIC MANAGEMENT
6	(SERVICE) PEST CONTROL
7	(RESEARCH) OFF ROAD EMISSIONS
8	(SERVICE) TECHNOLOGY TRANSFER
9	(SERVICE) SOFTWARE MACHINERY MANAGEMENT

MEMORANDUM TO: Members of the Crops Engineering Research and Services Subcommittee of the O.A.E.R.S.C.

Subject: AGENDA of half day meeting to be held Wednesday, October 27, 1999

The next meeting of the Crops Engineering Research and Services Subcommittee of the OAERSC will **take place at OMAFRA Head office Guelph, Ontario. Corner of Stone and Gordon. In Board room 205 on the second floor.**

Please come with a list of emerging issues, problems or concerns that you have, or the organization that you represent have, with respect to agricultural machinery, crop storage and equipment industry.

If you can not attend, please send the above information to me by Oct 21. Thank you.

AGENDA

8:45 am Introduction (coffee/donuts)

9:00 - 11:00 Discussion

1. New problems, issues or topics requiring research in the crops engineering area.

2. Identify service programs relative to crops engineering and consider recommendations on the needs for service, and ways to improve present programs and our need for new programs.

3. Review and summarize items 1 and 2 for input into report. (Chairman and secretary to write final copy).

11:00 - 12:30 Review The Ranking of Research and Service items for Enclosure in the 1999 Report

12:30 - 1:15 Lunch

NOTE: Please get in touch with me if you are unable to attend.

Stephen Clarke, P.Eng. Chairperson
OMAFRA, Box 2004,Kemptville, Ont.K0G 1J0.
Telephone: 613/258-8305 or Fax: 613/258-8392.

Enclosed is the 1999 report. Please bring the report to the meeting. Thanks.

10.3 Crops Engineering Committee Membership 2000

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